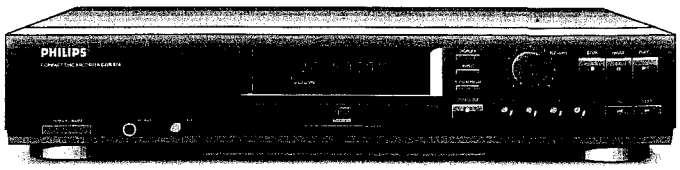
Compact disc recorder

CDR880

/00/06/11/17
/00S/06S/11S/17S

Service
Service
Service



Service Manual

Introduction of CDR880

For CDR880 we refer to the service manual of CDR870 service code number 4822 725 25241 except the following differences: V1022 1# 10150 46

Mechanical parts:

ITEM	NAME	CDR880/00/06/11/17	CDR880/00S/06S/11S/17S
1	FRONT ASSY	4822 459 04978	4822 459 04981
9	POWER ROD	= CDR870	4822 402 11065
51	LEVEL KNOB	= CDR870	4822 410 11809
53	VOLUME KNOB	= CDR870	4822 410 11811
65	TRAY FRONT	= CDR870	4822 459 04982
151	COVER	= CDR870	4822 442 01369
312-313	CINCH CABLE GOLD	4822 321 23116	4822 321 23116

CDR MODULE

The CDR module used in CDR880 is also different and can be ordered with service code number 4822 214 12745.

Electrical parts

A modified connector board to improve recordings via optical input has been implemented in CDR880.
The optical devices have been changed into a new type.
Optical receiver position 1520: GP1F32R. Service code number: 4822 218 11987.
Optical transmitter position 1521: GP1F32T. Service code number: 4822 130 10845.
See added circuit diagram and PCB drawing.

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Published by M.T. 9818 Service MMA P.I.A. Hasselt Printed in The Netherlands Subject to modification GB 4822 725 25245

PCS 84 050

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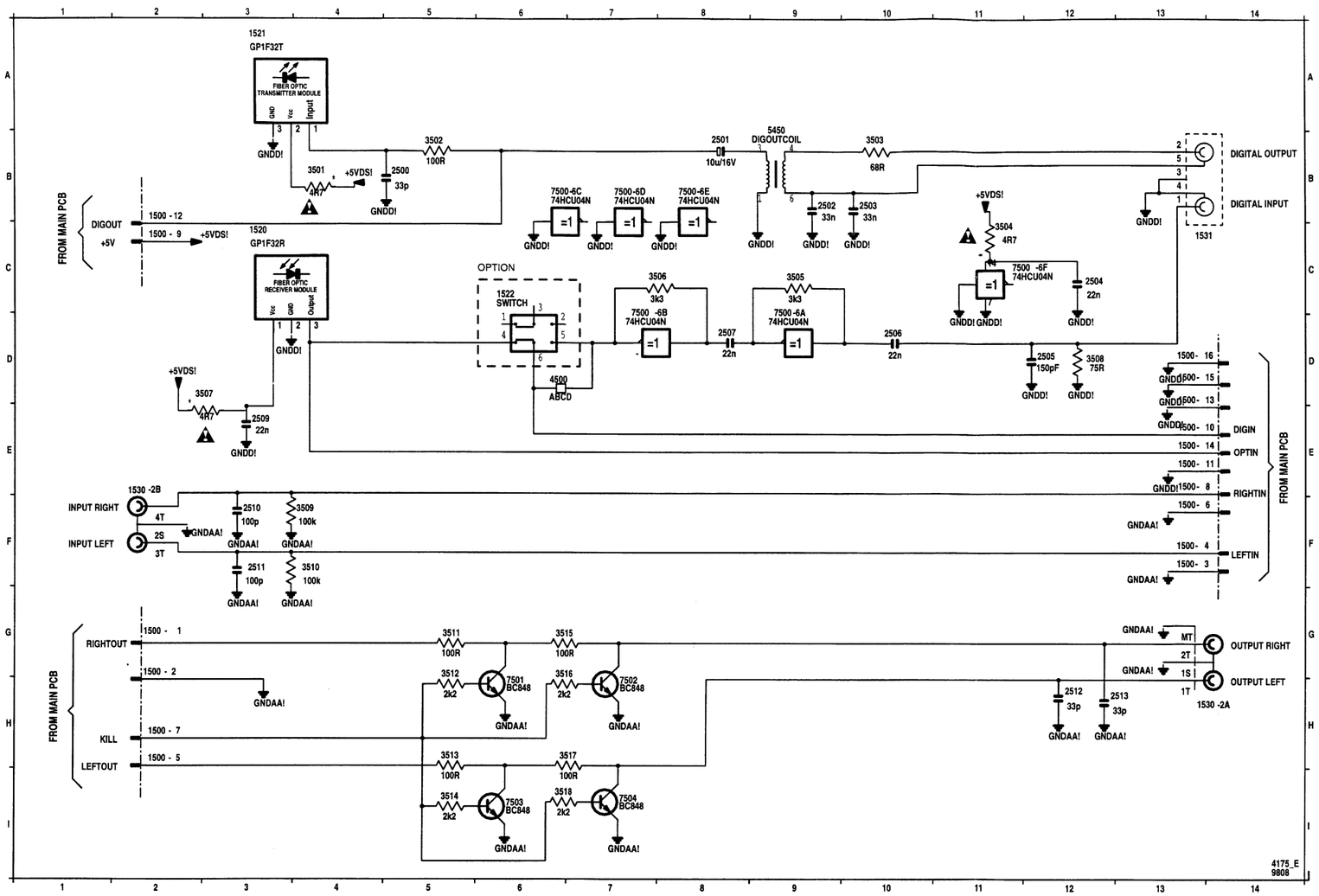
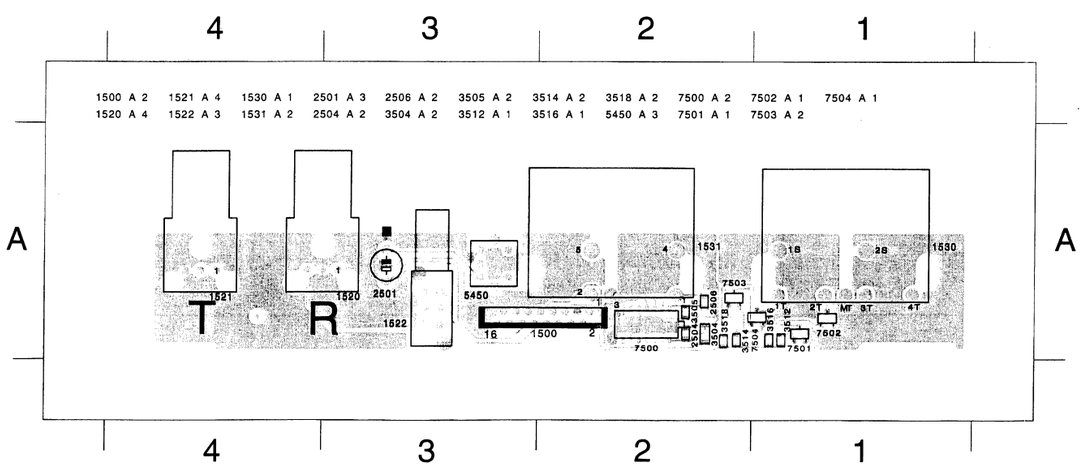
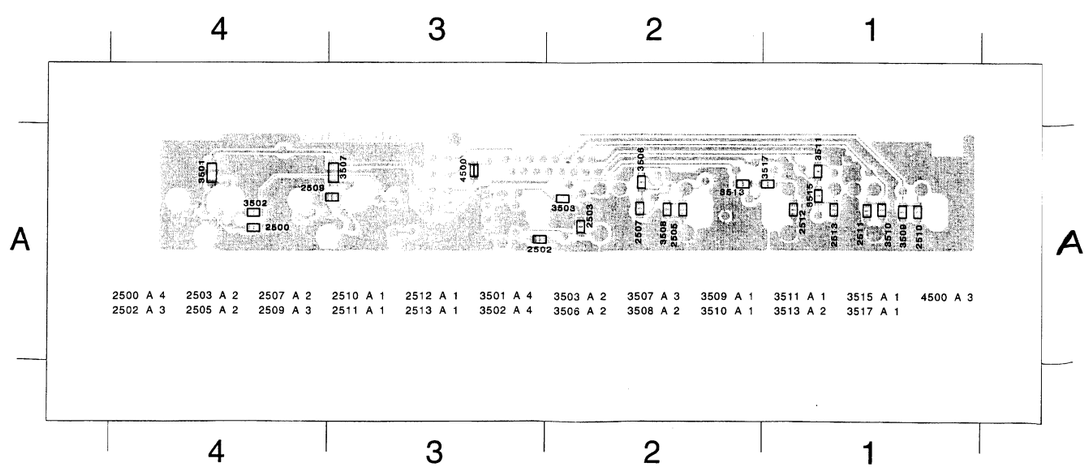
CONNECTOR BOARD





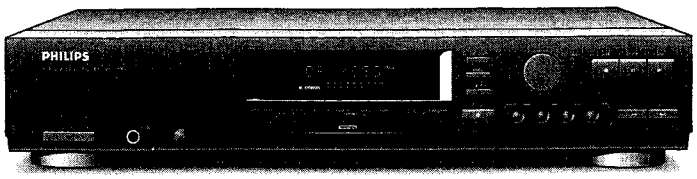


Compact disc recorder

CDR870

/00/11/17

Service
Service
Service



Service Manual

INTRODUCTION

With the introduction of the Philips CDR 870 CD-Recorder it is possible to make your audio CD at home. Of course the set can also playback pre-recorded audio CD's like the well-known audio CD-player. Recordings can be made from, as well as analogue, as digital audio sources.

More details are described in Circuit description: "The basics of Compact Disc Recordable/Rewritable" available via service codenumber 4822 725 25242.

SERVICING

For servicing CDR870 this set can be divided into two parts.

1. The Power supply board, Display board and the Connector interface board has to be repaired on component level.
2. The loader module with CD mechanism, CDM-board and the Main board will be exchanged completely in case of failure. For easy diagnostics the set has been equipped with a selfdiagnose program. Defective loader modules have to be returned to a central repairshop.

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COMPACT disc Recordable ReWritable

COMPACT disc DIGITAL AUDIO Recordable

COMPACT disc ReWritable

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GB 4822 725 25241

PCS 83 962

PHILIPS

TECHNICAL SPECIFICATIONS

General

1. Mains voltage
   /00 230V
   /11 110V-120V-220V-240V
   /17 120V
2. Mains frequency 50-60 Hz
3. Mains voltage selection
   only with multivoltage version /11
4. Power consumption 9W

Input/output

1. **Line output.**
   Output level: 2Vrms at 0dB.
   Output resistance: 200Ω.
2. **Line input.**
   input sensitivity: 700mVrms.
   Input impedance: 50kΩ.
   Maximum input voltage: 5Vrms.
3. **Digital output.**
   Format: AES/EBU format according IEC958 (consumer format).
   Sampling frequency: 44.1kHz.
   output resistance: 75Ω.
4. **Digital input.**
   Format: AES/EBU format according IEC958 (consumer format).
   Sampling frequency: 32, 44.1, 48kHz.
   Input resistance: 75Ω.
5. **Optical output.**
   Format: AES/EBU format according IEC958 (consumer format).
   Sampling frequency: 44.1kHz.
6. **Optical input.**
   Format: AES/EBU format according IEC958 (consumer format).
   Sampling frequency: 32, 44.1, 48kHz.

Audio performance

Cinch analog output (playback path).

Output voltage: 2Vrms ± 2dB. (0dB digital).
Frequency range F.R.: 20Hz < F.R. < 20kHz.
Amplitude linearity: ± 0.3dB.
typical.: ± 0.1dB.
Channel unbalance: <0.3dB at 1kHz.
typical: ±0.2dB.
Output resistance: 200Ω.
Phase non-linearity: <0.2deg at 1kHz.
Outband attenuation: 50dB above 30kHz.
Channel separation: >90dB at 1kHz.
typical: 110dB.
>85dB from 20Hz. until 20kHz.
typical: >93dB.
S/N-ratio A-weighted: >98dB.
typical: 105dB.
S/N-ratio unweightes: >95dB.
typical: 100dB.
Dynamic range: >95dB. at 1kHz.
typical: 100dB.
>90dB from 20Hz. until 20kHz.
typical: 98dB.
THD+N: >82dB from 20Hz. until 20kHz.
typical: 85dB.

Cinch analog input/output (monitor path).

Measured with Audio precision system one.
Input voltage is 2Vrms.

Output voltage: 2Vrms ± 2dB. (0dB digital).
Amplitude linearity: ± 0.3dB.
typical.: ± 0.1dB.
Channel unbalance: <0.3dB at 1kHz.
typical: ±0.2dB.
Output resistance: 200Ω.
Phase non-linearity: <0.2deg at 1kHz.
Outband attenuation: 50dB above 30kHz.
Channel separation: >90dB at 1kHz.
typical: 98dB.
>85dB from 20Hz. until 20kHz.
typical: >92dB.
S/N-ratio unweightes: >85dB.
typical: 90dB.
Dynamic range: >90dB. at 1kHz.
typical: 95dB.
THD+N: >81dB from 20Hz. until 20kHz.
typical: 85dB.
Intermodulation THD: >80dB.

Headphone output (all functions).

Output voltage: 0 - 5 Vrms / 8 - 2000Ω.
S/N: >80dB.
THD+N: >80dB.
Channel separation: >60dB from 20Hz. until 20kHz.

Dimensions and weight

1. Apparatus tray closed: WxDxH 435 x 305 x75
2. Weight without packaging: 4kg
3. Weight in packaging: 5kg

Laser Device Unit

1. Material: GaAlAs
2. Wave length: 775 →795 nm(at 25°C)
3. Laser output read: 0.7→0.9 mW
4. Laser output write: 13→18mW
5. Class laser: 3B

IMPORTANT NOTE

IMPORTANT NOTE FOR USERS IN THE UK

This apparatus is fitted with an approved 13 Amp plug.
To change a fuse in this type of plug, proceed as follows:

1. Remove fuse cover and fuse.
2. Fix new fuse which should be a BS1362 5A, A.S.T.A. or BSI approved type.
3. Refit the fuse cover.

If the fitted plug is not suitable for your socket outlets, it should be cut off and an appropriate plug fitted in its place.

If the mains plug contains a fuse, this should have a value of 5A. If a plug without a fuse is used, the fuse at the distribution board should not be greater than 5A.

NOTE

The severed plug must be destroyed to avoid a possible shock hazard should it be inserted into a 13A socket elsewhere.

How to connect a plug

The wires in the mains lead are coloured in accordance with the following code:
Blue - 'Neutral' ('N'); Brown - 'Live' ('L')

1. The Blue wire must be connected to the terminal which is marked with the letter 'N' or coloured Black.
2. The Brown wire must be connected to the terminal which is marked with the letter 'L' or coloured Red.
3. Do not connect either wires to the earth terminal in the plug which is marked by the letter 'E' or by the safety earth symbol or coloured green or green-and-yellow.

Before replacing the plug cover, make certain that the cord grip is clamped over the sheath of the lead - not simply over the two wires.

Copyright:

Recording and playback of material may require consent. See Copyright Act 1956 and The Performer's Protection Acts 1958 to 1972.

For Customer Use:

Read carefully the information located at the rear plate of your CD-Recorder and enter below the Serial N°.
Retain this information for future reference.

Model N°. .....CDR870.....
Serial N°.....

LASER SAFETY: This unit employs a laser. Only a qualified service person should remove the cover or attempt to service this device, due to possible eye injury.

CE The CDR870 is in conformity with the EMC directive and low-voltage directive.

NEVER MAKE OR CHANGE CONNECTIONS WITH THE POWER SWITCHED ON.

USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE OR OTHER UNSAFE OPERATION.

CLASS 1 LASER PRODUCT

KLASS 1 LASERAPPARAT

LUOKAN 1 LASERLAITE

(DK) Advarsel:

Usynlig laserudstråling ved åbning når sikkerhedsafbrydere er ude af funktion. Undgå udsættelse for stråling.

(S) Varning!

Om apparaten används på annat sätt än i denna bruksanvisning specificerats, kann användaren utsättas för osynlig laserstrålning, som överskrider gränsen för läserklass 1.

(SF) Varoitus!

Laitteen käyttäminen muulla kuin tässä käyttöohjeessa mainitulla tavalla saattaa altistaa käyttäjän turvallisuusluokan 1 ylittävälle näkymättömälle lasersäteilille.

PCS 83 964

INTRODUCTION

We want to thank you for choosing this Philips product, and welcome you to the growing family of Philips owners around the world.

With your Philips CD-Recorder, for the first time, you have the capability to make your own top-quality audio CDs, on either "write-once" CD-Recordable or re-usable CD-RW discs. Subject to certain legal constraints on copying, you can make your own CDs. The discs can be recorded all at once, or in stages.

Blank CD-R discs feature a dye layer for recording, and a "pre-groove" to guide the laser beam during recording. When fully recorded and 'finalized', they are 'fixed' for life, and will play on all CD-Players and CD-Recorders.

When recording signals on a CD-R disc with this unit, be sure to use the disc carrying the following mark and indication (disc for consumer use).

For Consumer or For Consumer use.

Recording will only be possible on a CD-R/CD-RW disc without the following mark . Recording is not possible on other discs (e.g. CD-R for professional use).

With the disc carrying this mark "FOR CONSUMER" or "FOR CONSUMER USE" indication, the copyright fee has already been paid to the copyright owner as defined in the relevant copyright law so that the user can record music on it for personal use.

However, if you want to use the disc for other purposes than personal use, you will have to obtain permission from the copyright owner.

Blank CD-RW discs feature a 'phase change' layer for recording, which changes from a crystalline (reflective) state to a amorphous (non-reflective) state under the influence of the laser beam. Because these changes are reversible, these discs can be erased and re-used. During recording, individual tracks can be erased; when fully recorded and 'finalized' CD-RW discs need to be erased completely before re-use. 'Finalized' CD-RW discs will play on all CD-RW compatible CD-Players and CD-Recorders.

Your CD-Recorder also plays all pre-recorded Cd's, as well as audio tracks from 'mixed' CDs such as CD-Extra.

Daily use will show you how simple it is to make your own CD. In spite of this, we advise you when trying it out for the first time, with the aid of these instructions, to use an erasable digital audio CD (CD-RW).

IMPORTANT

IT IS A CRIMINAL OFFENCE, UNDER APPLICABLE COPYRIGHT LAWS, TO MAKE UNAUTHORISED COPIES OF COPYRIGHT-PROTECTED MATERIAL, INCLUDING COMPUTER PROGRAMS, FILMS, BROADCASTS AND SOUND RECORDINGS. THIS EQUIPMENT SHOULD NOT BE USED FOR SUCH PURPOSES.

For the best musical performance, use Philips discs.

INSTALLATION

UNPACKING

First check and identify the contents of your CD-Recorder package, as listed below:

- CDR870 CD-Recorder
- Remote Control Handset with separately-packed batteries
- A.C. Power cord
- Audio cables (x2)
- Digital coaxial audio cable
- User Manual

If any item should be damaged or missing, please inform your supplier without delay.
Keep the packaging materials, you may need them to transport the CD-Recorder in the future.

POWER SUPPLY SETTING

Check that the voltage given on the type plate on the rear panel corresponds to your A.C. supply voltage.
Certain versions of this CD-Recorder have a voltage selector switch on the rear panel. Set this switch to your local supply voltage.

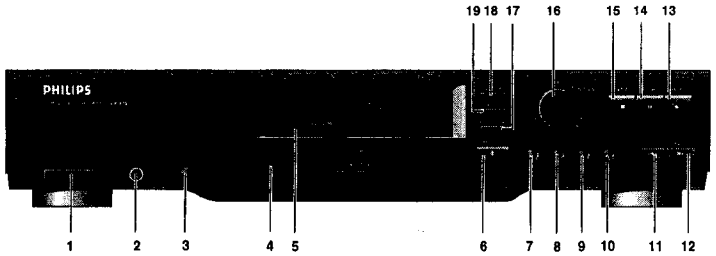
PLACEMENT

- Place the recorder on a firm, vibration-free surface.
- Keep the CD-Recorder away from domestic heating equipment and direct sunlight.
- Do not use the CD-Recorder in excessively humid environments.
- In a cabinet, allow a minimum of 2,5 cm (1 inch) of free space all around the CD-Recorder for adequate ventilation.

CAUTION

USE OF CONTROLS OR ADJUSTMENTS OR PERFORMANCE OF PROCEDURES OTHER THAN THOSE SPECIFIED HEREIN MAY RESULT IN HAZARDOUS RADIATION EXPOSURE OR OTHER UNSAFE OPERATION.

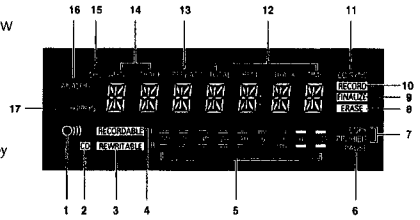
FRONT VIEW



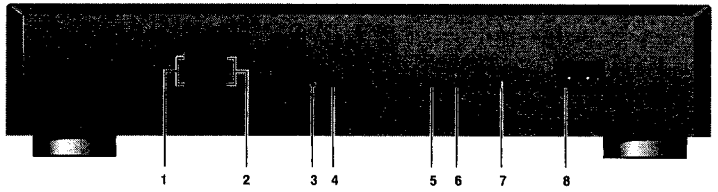
1. POWER ON/OFF
2. Headphone jack (PHONES)
3. Headphone level (LEVEL)
4. Disc tray
5. Display
6. OPEN/CLOSE
7. Record (REC)
8. FINALIZE
9. ERASE
10. CDSYNC
11. Previous track selection (PREV)
12. Next track selection (NEXT)
13. PLAY
14. PAUSE
15. STOP
16. Recording level control (analogue input)
17. AUTO/MANUAL track increment selection
18. DISPLAY indication selection
19. INPUT select

DISPLAY

1. Remote control active
2. CD (prerecorded CD or fully finalized CD-R or CD-RW disc) loaded.
3. REWRITABLE disc loaded for recording
4. RECORDABLE disc loaded for recording
5. Recording/playback level indicator
6. PAUSE (playback)
7. COPY PROHIBIT (digital recording not allowed)
8. ERASE last track or whole CD (flashes in Erase standby mode)
9. FINALIZE recorded disc (flashes in Finalize standby mode)
10. RECORD (flashes in Record standby mode)
11. CDSYNC recording
12. Track number and time
13. REPEAT (playback)
14. AUTOmatic TRACK increment
15. DIGital input
16. ANALOG input
17. PROGramme playback mode



REAR VIEW



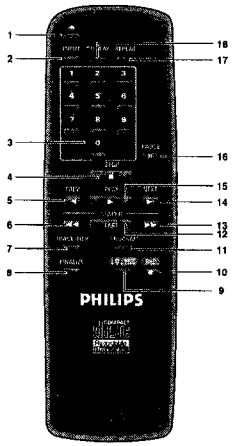
1. Analogue line input sockets
2. Analogue line output sockets
3. Digital input
4. Digital output
5. Optical digital input
6. Optical digital output
7. Voltage selector (not on all versions)
8. AC Mains input

CAUTION

DO NOT TOUCH THE INNER PINS OF REAR-PANEL CONNECTORS. ELECTROSTATIC DISCHARGE MAY CAUSE PERMANENT DAMAGE TO THE UNIT.

REMOTE CONTROL

1. OPEN/CLOSE
2. INPUT selector
3. Numeric buttons 0-9
4. STOP
5. PREVIOUS
6. Search reverse button
7. TRACK INCRement
8. FINALIZE
9. CDSYNC
10. REC
11. PROGRAM
12. FAST search button
13. Search forward button
14. NEXT
15. PLAY
16. PAUSE
17. REPEAT
18. DISPLAY indication modes



ENGLISH

CONNECTIONS

Note

– Numbers in parenthesis refer to the rear foldout.

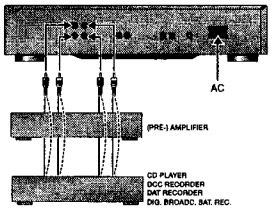
- You can use this CD-Recorder to record from any digital or analogue audio source, either via your (pre)amplifier or directly.
- You can also use it in the same way as a regular CD-player. Connections can be made as follows, depending on the facilities offered by the other audio equipment you have.
- Before making connections, remember to consult the user manual(s) for your other equipment.

ANALOGUE CONNECTIONS

- Connect the Left and Right Line Input ***(1)*** to the Left and Right Line Output of your (pre)amplifier (white to Left, red to Right), or directly to an analogue source, e.g. CD player, tuner, analogue satellite receiver, with the audio cable supplied.
- Connect the Left and Right Line Input ***(2)*** to the Left and Right Line Output of your (pre)amplifier (white to Left, red to Right), or directly to the analogue recorder or other analogue recorders.

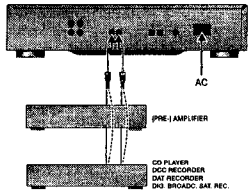
Note

– Do not connect the CD-Recorder to the amplifier's Phono input.



DIGITAL CONNECTIONS

- Connect the Digital coaxial input ***(3)*** to the Digital coaxial output of your digital (pre)amplifier, or directly to a digital source, e.g. CD-player, DCC Recorder, DAT Recorder, Digital Broadcast Satellite receiver, with the digital coaxial cable supplied.
- Connect the Digital coaxial output ***(4)*** to the Digital coaxial input of your digital (pre)amplifier, or directly to a digital Source, e.g. DCC Recorder, DAT Recorder, or another CD-R.



OPTICAL DIGITAL CONNECTIONS

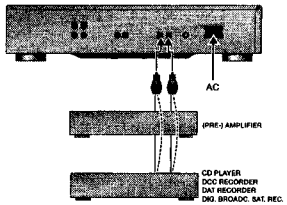
- Connect the Digital optical input ***(5)*** to the Digital optical output of your digital (pre)amplifier, or directly to a digital source, e.g. CD-player, DCC Recorder, DAT Recorder, Digital Broadcast Satellite receiver. Your dealer can supply a suitable fibre-optic link.
- Connect the Digital optical output ***(6)*** to the Digital optical input of your digital (pre)amplifier, or directly to a digital Source, e.g. DCC Recorder, DAT Recorder, or another CD-R. Your dealer can supply a suitable fibre-optic link.

CAUTION

ONLY A QUALIFIED SERVICE ENGINEER SHOULD REMOVE THE COVER OR ATTEMPT TO SERVICE THIS DEVICE.

Note

– Remove and retain the dust caps from the digital optical connectors and the fibre-optic link. Make sure that the dust caps are in place when the digital optical links are not in use.



- Plug the female end of the AC cable into the Power connector ***(8)***. Plug the male end of the cord into an AC outlet.

ENGLISH

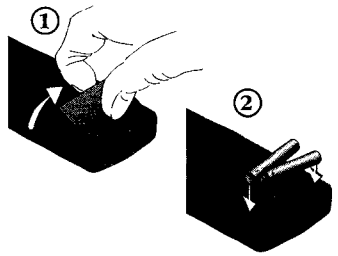
USING THE REMOTE CONTROL

Note

– Numbers in parenthesis refer to the front foldout.

Loading the batteries

- Open the battery compartment cover.
- Insert two "AA" (R6 or SUM3) batteries as indicated inside the battery compartment.
- Close the cover.



CAUTION

DO NOT MIX OLD AND NEW BATTERIES, AND NEVER MIX DIFFERENT TYPES OF BATTERIES (STANDARD, ALKALINE, AND SO ON).

Note

– The player cannot be switched on and off with the remote control. Always point the remote control directly at the CD-Recorder, making sure there are no obstructions in the path of the infrared beam. Whenever you press a button on the remote control, the 'receive' indicator on the CD-Recorder display lights up while the button is pressed.
– When there are corresponding buttons on the front panel, they can also be used.

SWITCHING ON AND OFF

- This function can only be operated on the recorder itself.
- On the front panel ***(1)***, press the Power ON/OFF to switch the CD-Recorder ON, and check that the display lights up.
- On the front panel ***(1)***, press the Power ON/OFF to switch the CD-Recorder OFF, and check that the display goes out.

LOADING AND UNLOADING A DISC

Loading a disc

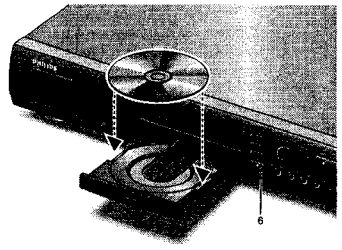
- Press Open/Close to open the disc tray.
- Lay the disc, label side up, correctly in the recess of the tray.
- To close the tray, press Open/Close again, or push gently on the front of the tray.

Note

– Suitable discs are: blank discs, partially or fully recorded digital audio CD-R or CD-RW discs and pre-recorded CD's.
– To play the disc (a pre-recorded CD or a fully or partially recorded CD-R or CD-RW disc) press Play.
– If the disc is a blank CD-R or CD-RW, the recorder calibrates it for optimal recording: during this process the display shows OPC, followed by the elapsed time and track number.

Unloading a disc

- Press Open/Close to open the disc tray.
- Lift the disc out of the tray.
- To close the tray, press Open/Close again, or push gently on the front of the tray.



RECORDING

CAUTION

NEVER SWITCH THE CD-RECORDER OFF DURING RECORDING OR THE DISC MAY BE CORRUPTED. IF POWER FAILS FOR ANY REASON DURING RECORDING, THE CD-RECORDER WILL TRY TO RECOVER THE DISC WHEN POWER RESTORED: DURING THIS PROCEDURE, THE DISPLAY WILL SHOW RECOVER.

- Check that the display indicates CD RECORDABLE or CD REWRITABLE: the recording procedure is the same for both disc types.
- If the disc is already partially recorded, the player automatically finds the end of the last recording so that the new recording follows on correctly.
- Recording is not possible unless at least 7 seconds of recording time is available on the disc. You can check this by pressing the Display key ***(18)*** to show the remaining recording time on the display.
- If the display shows COPY PROHIBIT, you cannot make a digital recording of the digital source material. The player's serial Copy Management System (SCMS) ensures that a recording of a digital source cannot be copied digitally again.
- Up to 99 tracks can be recorded on one disc.

ANALOGUE SOURCE

- If necessary, press Input ***(19)*** repeatedly to bring up ANALOG on the display.
- Select Auto or Manual Track Increment mode by pressing Auto/Manual ***(17)*** : the display shows AUTO TRACK when Auto Track Increment mode is selected.
- In Auto mode, a new track number is inserted each time the CD-Recorder detects a 3-second pause in the source material. In this mode, you cannot insert track numbers manually.

CAUTION

IF THE SOURCE MATERIAL CONTAINS PAUSES SHORTER THAN 3 SECONDS, YOU SHOULD INCREMENT THE TRACK NUMBERS MANUALLY. WE RECOMMEND THAT YOU ALWAYS INSERT TRACK NUMBERS MANUALLY WHEN RECORDING LONG-PLAYING RECORDS.

- In Manual mode, you can insert track numbers at any point you wish during recording by pressing Rec ***(7)*** or Track Incr., the minimum track length for this is 4 seconds. Track numbers cannot be inserted afterwards.
- Enter Record Standby mode by pressing Rec ***(7)*** : RECORD starts to flash on the display.
- Start play at the analogue source and adjust the recording level control on the front panel until, on the recording/playback level meter on the display, all the blue segments, but no red segments, light up during the loudest music passages.
- If you want a pause at the beginning of the new track, press Pause ***(14)***. A 3-second pause will be recorded.
- To start recording, press Play ***(13)***.
- The present track number and elapsed recording time appear on the display: to see the remaining recording time, press Display ***(18)***.
- In Auto mode, recording stops automatically if the recorder detects a 20-second pause in the source material. To stop recording in Manual and Auto mode, press Stop ***(15)***.
- When recording stops, the CD-Recorder automatically updates the disc's temporary Table Of Contents: during this process, the display shows UPDATE.
- When the disc is full, it must be finalized before it will play in the same way as a pre-recorded disc. See Finalizing a Disc.

DIGITAL SOURCE

For recording from CD, DCC, DAT or MD.

- If necessary, press Input ***(19)*** repeatedly to bring up DIG COAXIAL or DIG OPTICAL (depending on the input connection you are using) on the display.
- Select Auto or Manual Track Increment mode by pressing Auto/Manual ***(17)*** : the display shows AUTO TRACK when Auto Track Increment mode is selected.
- In Auto mode, track numbers are automatically entered from the digital source material. In this mode, you cannot insert track numbers manually.
- In Manual mode, you can insert track numbers at any point you wish during recording by pressing Rec ***(7)*** or Track Incr.
- Enter Record Standby mode by pressing Rec ***(7)*** : RECORD starts to flash on the display. If the digital input is not properly connected, DIG will flash on the display.
- To start recording, press Play ***(13)***.
- Start play at the digital source.
- The present track number and elapsed recording time appear on the display: to see the remaining recording time, press Display ***(18)***.
- In Auto mode, recording stops automatically if the recorder detects a 20-second pause in the source material. To stop recording in Manual and Auto mode, press Stop ***(15)***.
- When recording stops, the CD-Recorder automatically updates the disc's temporary Table Of Contents: during this process, the display shows UPDATE.
- When the disc is full, it must be finalized before it will play in the same way as a pre-recorded disc. See Finalizing a Disc. So a disc that is not finalized cannot be played on another CD player, unless the player concerned is also a CD recorder. Non-finalized CD-R discs can always be played on the CD recorder itself. It is also possible to add recordings later on if sufficient recording time is available.

AUTOMATIC DIGITAL SOURCE RECORDING - CDSYNC

For synchronous recording of individual tracks or an entire disc from CD, DCC, DAT or MD.

- If necessary, press Input ***(19)*** repeatedly to bring up DIG COAXIAL or DIG OPTICAL (depending on the input connection you are using) on the display.

Note

– Do not record programmed playback from DCC or DAT: this causes incorrect track numbering: always record tracks in their original (non-programmed) sequence.

- Ensure that the digital source is not playing.
- For single-track recording, press CDSYNC ***(10)*** : the display will indicate SYNC-1.
- For all-track recording, press CDSYNC ***(10)*** twice in rapid succession: the display will indicate SYNC.
- Wait for the CD-Recorder to enter Record Standby mode, when RECORD starts to flash on the display. If the digital input is not properly connected, DIG will flash on the display.
- Press Play on the digital source. Recording will start automatically. If you press Play in the middle of a track, the CDSYNC function will only start at the next track.
- The present track number and elapsed recording time appear on the display: to see the remaining recording time, press Display ***(18)***.
- In Auto mode, recording stops automatically if the recorder detects a 20-second pause in the source material. To stop recording in Manual and Auto mode, press Stop ***(15)***.
- When recording stops, the CD-Recorder automatically updates the disc's temporary Table Of Contents: during this process, the display shows UPDATE.
- When the disc is full, it must be finalized before it will play in the same way as a pre-recorded disc. See Finalizing a Disc.

Note

– If you do not want a 20-second pause to be recorded, you should stop recording manually.

FINALIZING A DISC

Note

– Once finalization has begun, the CD-Recorder will accept no operational commands until the process is completed.

– Do not switch off or disconnect the CD-Recorder during finalization: this can corrupt the disc.

- If necessary, load the disc to be finalised into the CD-Recorder.
- With the CD-Recorder stopped, press Finalize ***(8)***, then press Rec ***(7)*** within 2 seconds.
- The time needed for finalizing is displayed (approx. 2 minutes). Finalization is completed as soon as the total number of tracks and the recording time are displayed.
- When a CD-R is finalized, no further recording is possible on the disc.
- When a CD-RW is finalized, the disc must be erased completely before re-recording.

ERASING A CD-RW DISC

Note

– Before the disc is finalized, the tracks can be erased individually from the last recorded track backwards. After finalization, the entire disc must be erased before re-recording.

– Do not switch off the CD-Recorder during erasing.

ERASE last Recording

- If necessary, load the disc to be erased into the CD-Recorder.
- With the CD-Recorder stopped, press Erase ***(9)*** once to erase the last track: the display will show ERASE TRACK.
- Press Rec ***(7)*** to start erasure: during erasure ERASE and RECORD will appear on the display.

ERASE total disc

- With the CD-Recorder stopped, press Erase ***(9)*** twice within 2 seconds to erase the complete disc: the display will show ERASE DISC.
- Press Rec ***(7)*** within 2 seconds to start erasure. During erasure ERASE and RECORD will appear on the display. This process may last 1.5 minutes.

PLAY

- To start play, press Play, you can do this with the disc tray either open or closed.
- The display shows the track number and the elapsed playing time. To see the remaining track time, press Display ***(18)***. To see the total remaining time, press display ***(18)*** a second time. To switch the Level meter off and return to elapsed playing time, press Display a third time. You can switch the Level meter ***(16)*** on and off as required by repeating the complete sequence.
- To interrupt play temporarily, press Pause ***(14)***. Press again to resume play.
- To skip forward to the next track, press Next ***(12)***.
- To skip back to the previous track, press Previous ***(11)***.
- To go to any track, enter the track number with the numeric buttons on the remote control. For 2-digit track numbers, enter both digits in quick succession.
- To search forwards or backwards at 2x play speed, press Search Forward or Search Reverse.
- To search forwards or backwards at 8x play speed, press Fast, followed within 2 seconds by Search Forward or Search Reverse.
- To repeat the track in play, press Repeat: the display shows Repeat 1.
- To repeat the entire disc or programme, press Repeat a second time: the display shows Repeat.

PROGRAMMED PLAY

- With the CD-Recorder stopped, press Program on the remote control.
- Enter the tracks you want to play using the numeric keys: For 2-digit track numbers, enter both digits in quick succession.
- You can program up to 20 tracks in any order.
- To play your program, press play.
- To cancel the program, press Stop twice, or open the disc tray.

SPECIFIC DISPLAY MESSAGES

MESSAGE	MEANING
Reading	reading disc info
OPC	power calibration in progress for optimal recording
No Disc	no disc inside or disc is unreadable
Update	table of contents being updated after recording
Wait	the player is busy with internal actions
Full	the program contains 20 tracks, and is full
CD Full	no recordable space is left on the disc
Empty	no recordings on disc; finalizing is not possible
Input	digital input not selected for cdsync
Final	OPC has been carried out 96 times; please finalize the disc
Recover	recovery procedure in progress after fault during recording. If recovery fails, the CD-R disc - unlike the CD-RW - may have become useless.
OPC Fail	OPC has failed; disc is corrupted or player is defective
Service	self-check by the recorder has failed; see 'Before requesting service'; contact service
No Audio	no audio information on disc. You are trying to make a recording on a CD-R disc which is not intended for digital audio (see 'Introduction' of these instructions).

ENGLISH

BEFORE REQUESTING SERVICE

If it appears that your CD-Recorder is faulty, first consult this check list. It may be that something simple has been overlooked. Under no circumstances attempt to repair the recorder yourself. This will invalidate the warranty.

SYMPTOM	REMEDY
No power	• Check that the power button is set ON. • Check the power cord connection. • Reset the recorder by switching OFF and ON again.
No sound	• Check the audio connections. • If using an amplifier, try another source.
Distorted sound from amplifier	• Ensure that the CD-Recorder line out connections have not been made to the phono input
No start-up	• Check the disc label is upwards. • Clean the disc. • Check if the disc is defective by trying another disc.
Remote control does not work	• Aim the remote at the CD-Recorder. • Inspect or replace the batteries.
Recording not possible	• No recordable disc inside. • Check the disk or replace the disc. • No audio disc inside.
Recording is distorted	• Check if the record level has been set too high.
20-second pause between recordings	• See CDSYNC, page 7.

OTHER INFORMATION

If the recorder remains faulty you can start the Diagnostic Program in the recorder.

How does the Diagnostic Program works:

You can operate the Diagnostic Program by following the instructions step by step:

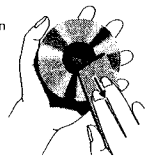
1 Switch the recorder off with the POWER ON/OFF button.
2 Press the PLAY and STOP button simultaneously and keep them pressed while you switch on the recorder with the POWER ON/OFF button.
3 On the display appears the flashing message: BUSY.
4 After a few minutes the message on the local display changes over from BUSY into ERROR or into PASSED.
5 When the message ERROR appears on the display there is apparently a failure in your recorder and your recorder has to be repaired.
6 Consult your dealer or the Philips Consumer Information Centre (CIC) for the nearest Service Repair Shop in your country.
7 When the message PASSED appears on the display there is no obvious failure in your recorder in this case the failure can be caused by a wrong interpretation of the operating instructions or a wrong disc is used a mechanical failure or your recorder is not correctly connected.
In this case you should read the operating instructions again or consult your dealer.
8 When the problem remains then go to point 6 of this instuction for finding the nearest repair shop.
9 Switch the recorder off with the POWER ON/OFF button to leave the Diagnostic Program.

CARE OF THE RECORDER

A chamois leather slightly moistened with water is sufficient for cleaning the player. Do not use cleaning agents containing alcohol, spirits, ammonia or abrasives.

CARE OF DISCS

As with pre-recorded CDs, the presence of fingerprints or smudges on the disc surface will not directly affect the recorded signals but, depending on the degree of contamination, the brightness of the reflected signal may be reduced sufficiently to degrade the sound quality.



- When writing on the printed side of a CD-R, use a soft, felt tip marker. Never use a hard-tipped pen (ballpoint) as it may damage the recording.
- Keep the shiny surface of the disc clean. Use a soft lint-free cloth and always wipe the disc in a straight line from centre to edge.
- Never use cleaning agents indended for conventional records.
- Never use detergents or abrasive cleaning agents.
- Never expose the disc to direct sunlight or to extremely high temperatures.

GENERAL

• System	: compact disc digital audio
• Number of channels	: 2 (stereo)
• Applicable discs	: CD, CD-R, CD-RW
• Power supply	: AC 230V(/00), 120V(/17), 120/230V(/11)
• Power consumption	: tbf
• Operating temperature	: 5-35°C
• Weight	: tbf
• Dimensions	: 435(W)x310(D)x75(H) mm

ACCESSORIES

- Remote control (+batteries)
- Audio cable (x2)
- Digital coaxial cable (x1)
- AC mains cable

AUDIO

• Frequency response	: 20Hz-20kHz
• Playback S/N	: 105dB
• Playback dynamic range	: 98dB
• Playback total harmonic distortion	: 85dB
• Recording S/N	: 90dB
• Recording dynamic range	: 95dB
• Recording total harmonic distortion	: 85dB
• Line output voltage	: 2Vrms
• Digital coaxial output	: 0.5V(pp)/75Ω
• Digital optical output	: -20dBm
• Headphones	: 0-5Vrms/8-2000Ω
*recording values for line input/output	
• Digital coaxial input (automatic sample rate conversion)	: 32-48kHz
• Digital optical input (automatic sample rate conversion)	: 32-48kHz
• Analogue input	: 700mVrms/50kΩ

PLAYBACK FUNCTIONS

- Play
- Pause
- Stop
- Direct track selection
- Next/Previous track selection
- Search forward/reverse
- Fast search forward/reverse
- Repeat (all/1-track)
- Program play (20 tracks)
- Time display switching

RECORDING FUNCTIONS

- Recording
- Auto Start Recording (Cdsync)
- Pause recording
- Erase last track (CD-RW disc)
- Erase disc (CD-RW disc)
- Manual Track Increment
- Automatic Track Increment
- Remaining recording time display
- Finalize (writing TOC)
- SCMS (Serial Copy Management System)

(GB) WARNING

All ICs and many other semi-conductors are susceptible to electrostatic discharges (ESD).
Careless handling during repair can reduce life drastically.
When repairing, make sure that you are connected with the same potential as the mass of the set via a wrist wrap with resistance.
Keep components and tools also at this potential.

ESD

(NL) WAARSCHUWING

Alle IC's en vele andere halfgeleiders zijn gevoelig voor elektrostatische ontladingen (ESD).
Onzorgvuldig behandelen tijdens reparatie kan de levensduur drastisch doen verminderen.
Zorg ervoor dat u tijdens reparatie via een polsband met weerstand verbonden bent met hetzelfde potentiaal als de massa van het apparaat.
Houd componenten en hulpmiddelen ook op ditzelfde potentiaal.

(F) ATTENTION

Tous les IC et beaucoup d'autres semi-conducteurs sont sensibles aux décharges statiques (ESD).
Leur longévité pourrait être considérablement écourtée par le fait qu'aucune précaution n'est prise a leur manipulation.
Lors de réparations, s'assurer de bien être relié au même potentiel que la masse de l'appareil et enfiler le bracelet serti d'une résistance de sécurité.
Veiller a ce que les composants ainsi que les outils que l'on utilise soient également a ce potentiel.

(D) WARNUNG

Alle IC und viele andere Halbleiter sind empfindlich gegen elektrostatische Entladungen (ESD).
Unsorgfältige Behandlung bei der Reparatur kann die Lebensdauer drastisch vermindern.
Sorgen sie dafür, das Sie im Reparaturfall über ein Pulsarmband mit Widerstand mit dem Massepotential des Gerätes verbunden sind.
Halten Sie Bauteile und Hilfsmittel ebenfalls auf diesem Potential.

(I) AVVERTIMENTO

Tutti IC e parecchi semi-conduttori sono sensibili alle scariche statiche (ESD).
La loro longevita potrebbe essere fortemente ridatta in caso di non osservazione della piu grande cauzione alla loro manipolazione.
Durante le riparazioni occorre quindi essere collegato allo stesso potenziale che quello della massa dell'apparecchio tramite un braccialetto a resistenza.
Assicurarsi che i componenti e anche gli utensili con quali si lavora siano anche a questo potenziale.

(GB)
Safety regulations require that the set be restored to its original condition and that parts which are identical with those specified be used.

(D)
Bei jeder Reparatur sind die geltenden Sicherheitsvorschriften zu beachten.
Der Originalzustand des Gerats darf nicht verandert werden.
Fur Reparaturen sind Original-Ersatzteile zu verwenden.

(NL)
Veiligheidsbepalingen vereisen, dat het apparaat in zijn oorspronkelijke toestand wordt terug gebracht en dat onderdelen, identiek aan de gespecifieerde worden toegepast.

(I)
Le norme di sicurezza esigono che l'apparecchio venga rimesso nelle condizioni originali e che siano utilizzati pezzi di ricambiago idetici a quelli specificati.

(F)
Les normes de sécurité exigent que l'appareil soit remis a l'état d'origine et que soient utilisées les pièces de rechange identiques à celles spécifiées.

CAUTION INVISIBLE LASER RADIATION WHEN OPEN. AVOID EXPOSURE TO BEAM.
VARO! AVATTAESSA OLET ALTTIINA NÄKYMÄTTÖMÄLLE LASER SÄTTEILYLLE ÄLÄ KATSO SÄTEESEN.
VARNING OSYNLIG LASERSTRÅLNING NÄR DENNA DEL ÄR ÖPPNAD BETRAKTA EJ STRÅLEN.
ADVERSEL USYNLIG LASERSTRÅLING VED ÅBNING. UNDGÅ UNSAETTELSE FOR STRÅLING.
DANGER INVISIBLE LASER RADIATION WHEN OPEN. AVOID DIRECT EXPOSURE TO BEAM.
VORSICHT UNSICHTBARE LASERSTRAHLUNG WENN ABDECKUNG GEÖFFNET. NICHT DEM STRAHL AUSSETZEN.

SHOCK, FIRE HAZARD SERVICE TEST:

CAUTION: After servicing this appliance and prior to returning to customer, measure the resistance between either primary AC cord connector pins (with unit NOT connected to AC mains and its Power switch ON), and the face or Front Panel of product and controls and chassis bottom,
Any resistance measurement less than 1 Megohms should cause unit to be repaired or corrected before AC power is applied, and verified before return to user/customer.
Ref.UL Standard NO.1492.

NOTE ON SAFETY:

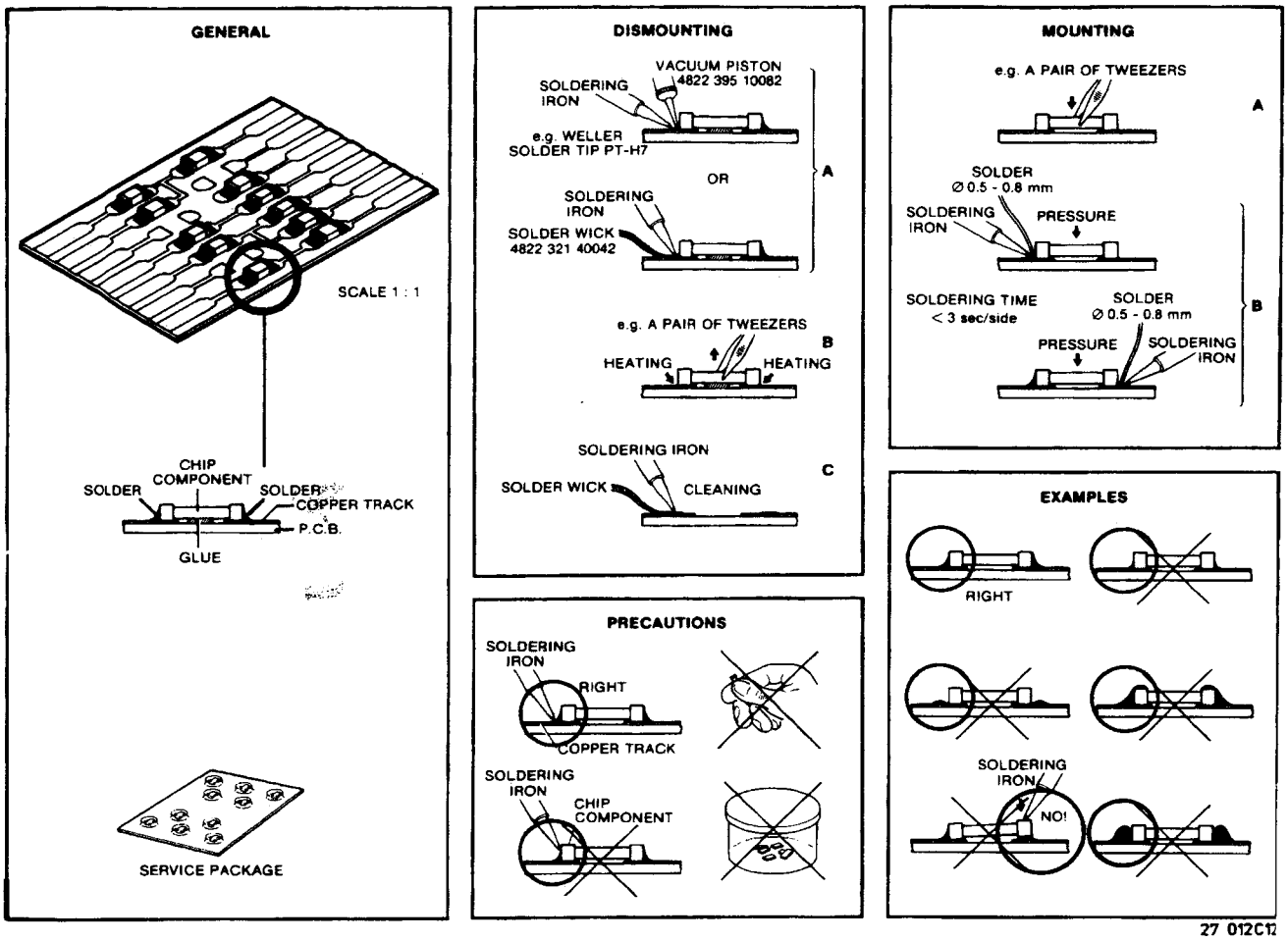
Symbol ⚠ : Fire or electrical shock hazard. Only original parts should be used to replace any part with symbol ⚠
Any other component substitution(other than original type), may increase risk or fire or electrical shock hazard.

CLASS 1
LASER PRODUCT
3122 110 03420

"Pour votre sécurité, ces documents doivent être utilisés par des spécialistes agrées, seuls habilités à réparer votre appareil en panne."

SERVICING HINTS

In the set chip components have been applied. For disassembly and assembly of chip components see the figure below.



SERVICE TOOLS

Audio signals disc	4822 397 30184
Disc without errors(SBC444) and disc with DO errors, black spots and fingerprints(SBC444A)	4822 397 30245
Disc(65 min , 1 kHz) without no pause	4822 397 30155
Maximum diameter disc(58.0 mm)	4822 397 30144
Torx screwdrivers	
Set (straight)	4822 395 50145
Set (square)	4822 395 50132

SAFETY GUIDELINES FOR THE PROFESSIONAL SERVICE TECHNICIAN

Important

Proper service and repair is important to the safe, reliable operation of all Philips equipment. The service procedures recommended by Philips and described in this service manual are effective methods of performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when and as recommended.

It is important to note that this manual contains various CAUTIONS and NOTICES which should be carefully read in order to minimize the risk of personal injury to service personnel. The possibility exists that improper service methods may damage the equipment. It also is important to understand that these CAUTIONS and NOTICES ARE NOT EXHAUSTIVE. Philips could not possibly know, evaluate and advise the service trade of all conceivable ways in which service might be done or of the possible hazardous consequences of each way. Consequently, Philips has not undertaken any such broad evaluation. Accordingly, a servicer who uses a service procedure or tool which is not recommended by Philips must first satisfy himself thoroughly that neither his safety nor the safe operation of the equipment will be jeopardized by the service method selected.

Safety Checks

After the original service problem has been corrected, a complete safety check should be made. Be sure to check over the entire set, not just the areas where you have worked. Some previous servicer may have left an unsafe condition, which could be unknowingly passed on to your customer. Be sure to check all of the following:

Fire and Shock Hazard

1. Be sure all components are positioned in such a way as to avoid the possibility of adjacent component shorts. This is especially important on those units which are transported to and from the service shop.
2. Never release a repaired unit unless all protective devices such as insulators, barriers, covers, strain reliefs, and other hardware have been installed according to the original design.
3. Soldering and wiring must be inspected to locate possible cold solder joints, solder splashes, sharp solder points, frayed leads, pinched leads, or damaged insulation (including the ac cord). Be certain to remove loose solder balls and all other loose foreign particles.
4. Check across-the-line components and other components for physical evidence of damage or deterioration and replace if necessary. Follow original layout, lead length, and dress.
5. No lead or component should touch a resistor rated at 1 watt or more. Lead tension around protruding metal surfaces or edges must be avoided.
6. Critical components having special safety characteristics are identified with a ⚠ by the Ref. No. in the parts list and enclosed within a broken line* (where several critical components are grouped in one area) along with the safety symbol ⚠ on the schematic diagrams and/or exploded views.

   Replacement parts without the same safety characteristics may create shock, fire, or other hazards.
7. When servicing any unit, always use a separate isolation transformer for the chassis. Failure to use a separate isolation transformer may expose you to possible shock hazard, and may cause damage to servicing instruments.
8. Many electronic products use a polarized ac line cord (one wide pin on the plug). Defeating this safety feature may create a potential hazard to the servicer and the user. Extension cords which do not incorporate the polarizing feature should never be used.

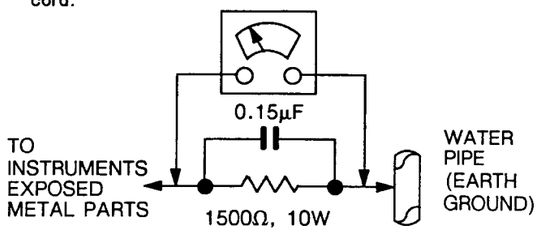
Fire and Shock Hazard (Continued)

9. After reassembly of the unit, always perform an ac leakage test or resistance test from the line cord to all exposed metal parts of the cabinet. Also, check all metal control shafts (with knobs removed), antenna terminals, handles, screws, etc. to be sure the unit is safe to operate without danger of electrical shock.

* Broken line: ▬ ▪ ▬ ▪ ▬ ▪ ▬ ▪ ▬ ▪

Leakage Current Cold Check

1. Unplug the ac line cord and connect a jumper between the two prongs of the plug.
2. Turn on the power switch.
3. Measure the resistance value between the jumpered ac plug and all exposed cabinet parts of the receiver, such as screw heads, antennas, and control shafts. When the exposed metallic part has a return path to the chassis, the reading should be between 1 megohm and 5.2 megohms. When the exposed metal does not have a return path to the chassis, the reading must be infinity. Remove the jumper from the ac line cord.



Leakage Current Hot Check

1. Do not use an isolation transformer for this test. Plug the completely reassembled unit directly into the ac outlet.
2. Connect a 1.5k, 10W resistor paralleled by a 0.15uF. capacitor between each exposed metallic cabinet part and a good earth ground such as a water pipe, as shown above.
3. Use an ac voltmeter with at least 5000 ohms/volt sensitivity to measure the potential across the resistor.
4. The potential at any point should not exceed 0.75 volts. A leakage current tester may be used to make this test; leakage current must not exceed 0.5 milliamps. If a measurement is outside of the specified limits, there is a possibility of shock hazard. The receiver should be repaired and rechecked before returning it to the customer.
5. Repeat the above procedure with the ac plug reversed. (Note: An ac adapter is necessary when a polarized plug is used. Do not defeat the polarizing feature of the plug.)

Parts Replacement

1. Many electrical and mechanical parts in Philips equipment have special safety related characteristics. These characteristics are often not evident from visual inspection nor can the protection afforded by them necessarily be obtained by using replacement components rated for higher voltage, wattage, etc. The use of a substitute part which does not have the same safety characteristics as the Philips recommended replacement part shown in this service manual may create shock, fire, or other hazards. Under no circumstances should the original design be modified or altered without written permission from Philips. Philips assumes no liability, express or implied, arising out of any unauthorized modification of design. Servicer assumes all liability.
2. All ICs and many other semiconductor parts are susceptible to electrostatic discharges (ESD). Careless handling during repair can reduce the life of the part drastically.

LASER NOTE:

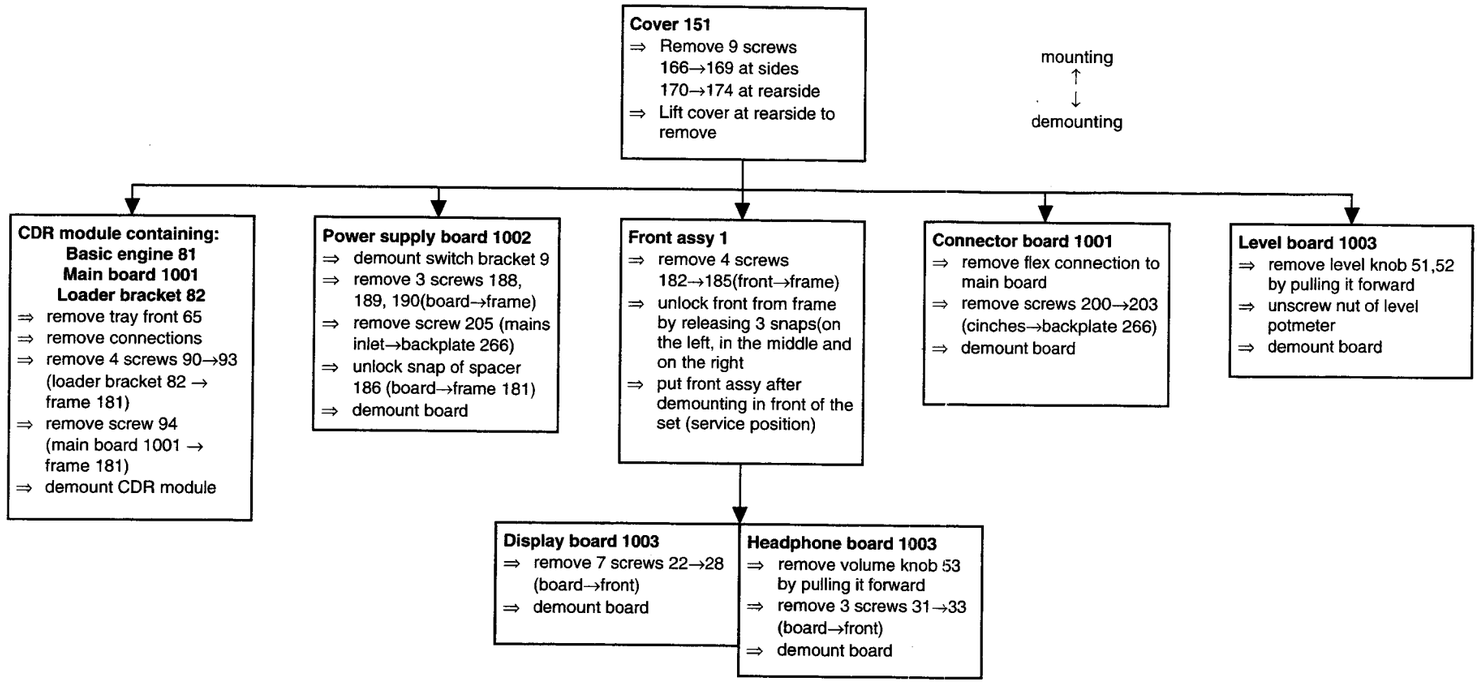
DANGER - Invisible laser radiation when open. AVOID DIRECT EXPOSURE TO BEAM.
CAUTION - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.
CAUTION - The use of optical instruments with this product will increase eye hazard.

11

12

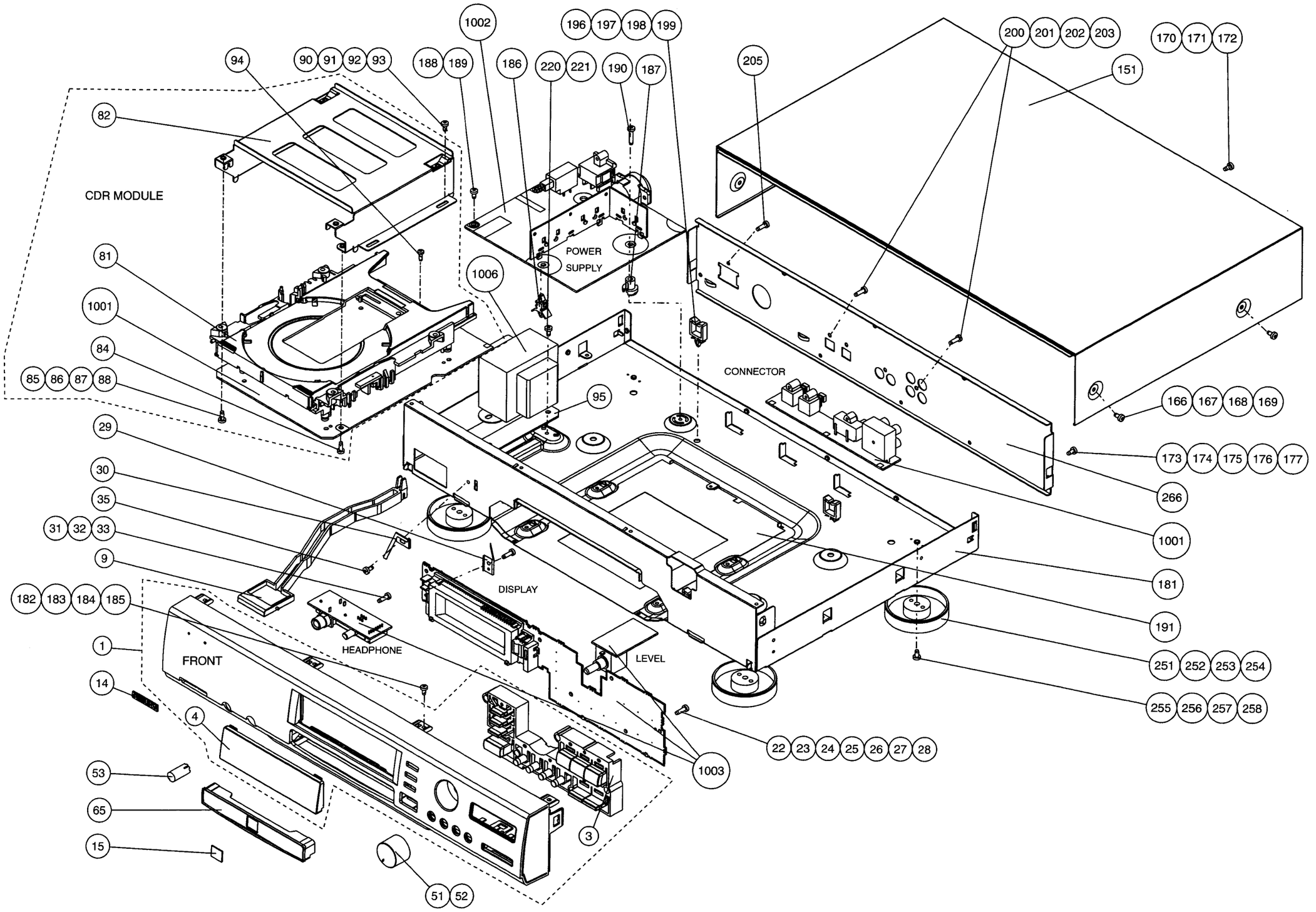
DISMANTLING INSTRUCTIONS

See exploded view for item numbers


Cover 151
⇒ Remove 9 screws 166→169 at sides 170→174 at rearside
⇒ Lift cover at rearside to remove
mounting
demounting
CDR module containing:
Basic engine 81
Main board 1001
Loader bracket 82
⇒ remove tray front 65
⇒ remove connections
⇒ remove 4 screws 90→93 (loader bracket 82 → frame 181)
⇒ remove screw 94 (main board 1001 → frame 181)
⇒ demount CDR module
Power supply board 1002
⇒ demount switch bracket 9
⇒ remove 3 screws 188, 189, 190(board→frame)
⇒ remove screw 205 (mains inlet→backplate 266)
⇒ unlock snap of spacer 186 (board→frame 181)
⇒ demount board
Front assy 1
⇒ remove 4 screws 182→185(front→frame)
⇒ unlock front from frame by releasing 3 snaps(on the left, in the middle and on the right
⇒ put front assy after demounting in front of the set (service position)
Connector board 1001
⇒ remove flex connection to main board
⇒ remove screws 200→203 (cinches→backplate 266)
⇒ demount board
Level board 1003
⇒ remove level knob 51,52 by pulling it forward
⇒ unscrew nut of level potmeter
⇒ demount board
Display board 1003
⇒ remove 7 screws 22→28 (board→front)
⇒ demount board
Headphone board 1003
⇒ remove volume knob 53 by pulling it forward
⇒ remove 3 screws 31→33 (board→front)
⇒ demount board

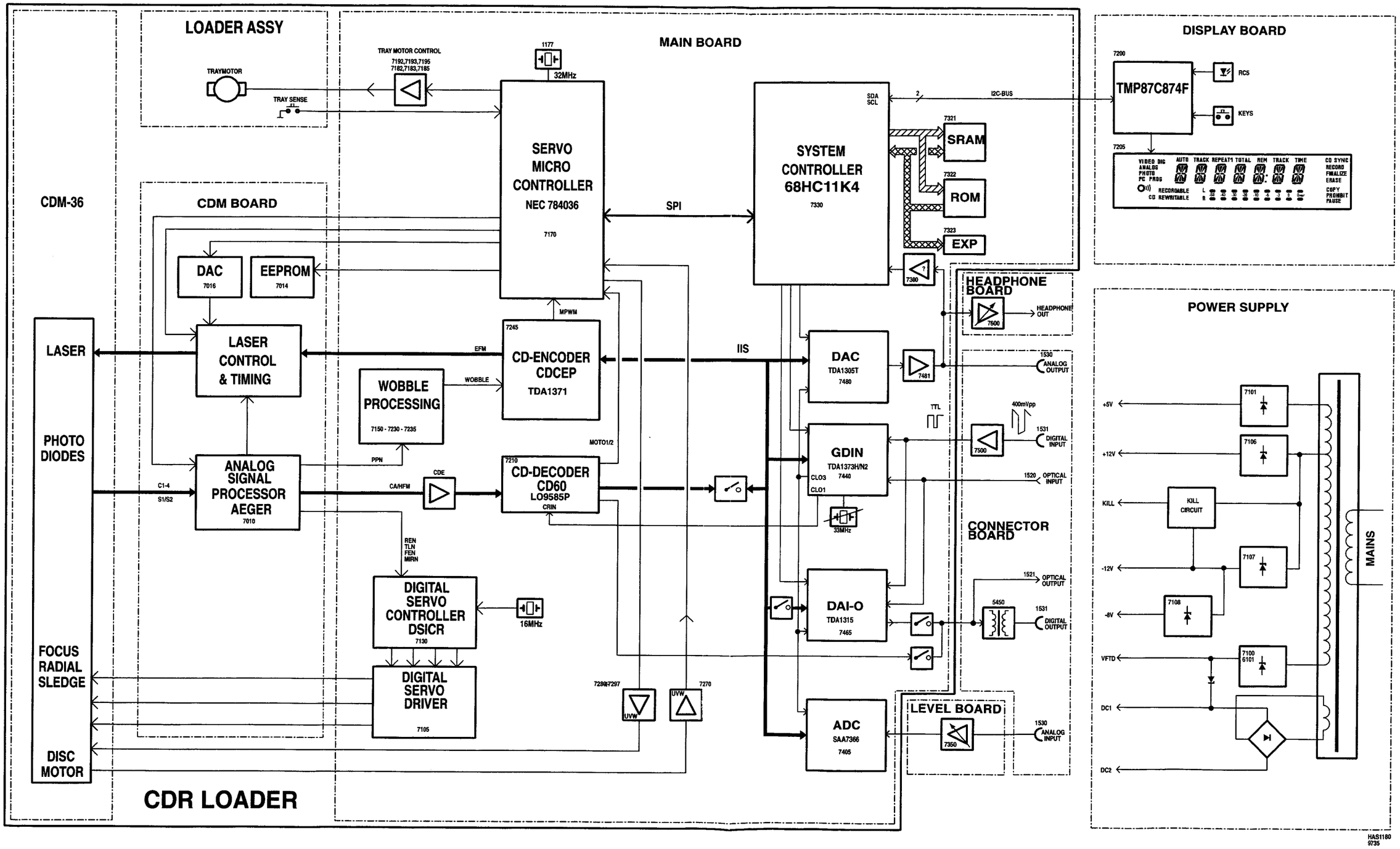
13

EXPLODED VIEW



14

OVERALL BLOCKDIAGRAM



SIGNALS AND ABBREVIATIONS

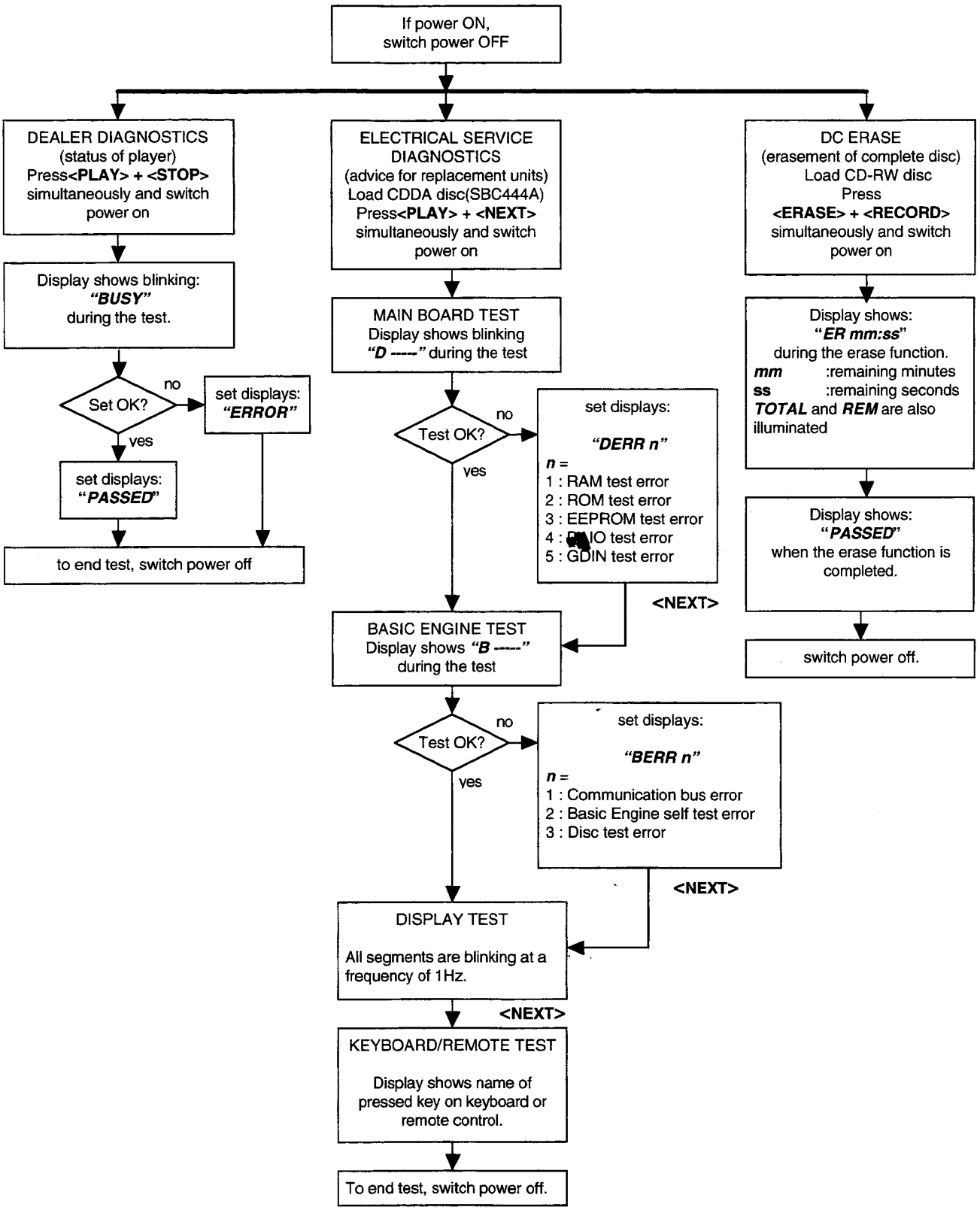
SIGNAL NAME	SIGNAL FLOW	FUNCTION AND DESCRIPTION
+12Va		Single power supply +12V for op-amps 7150, 7235
+12Vb		Power supply +12V for op-amps
+4V		Power supply +4V for servo microcontroller
+5Va		Analog power supply +5V
+5Vb		Digital power supply +5V
+5VDS		Power supply +5V for Connector Part
+5VM		Power supply turntable motor control circuit
+VP		Power supply User processsor & memories
-12Vb		Power supply -12V for op-amps
-8V		Power supply -8V
A1A	IC7170→CONN.1101	Calculation β and HF0 Positive peak detector between CA and CALF
A2A	IC7170→CONN.1101	Beta = (A1-A2)/(A1+A2) Negative peak detector between CA and CALF
ACK	IC7320↔R3904(IC7170) IC7320↔CONN.1300	Acknowledge serial communication user microprocessor
AD[0:17]	IC7320→IC7321 IC7320→IC7322	Address bus
ADC		Analog/Digital Converter
ATSB	IC7323→IC7480	Attenuation 12 dB of DAC(active low) during search
BS	IC7320→IC7440	Block synchronisation
CA	CONN.1101→R3299	Central Aperture(C1+C2+C3+C4)DC →for Mod. calculation
CALF	IC7170→CONN.1101	CA low frequency
CD60		Decoder
CDAICL	IC7320→IC7465 IC7320→CONN.1302	DAI-O interface clock
CDAIDA	IC7320↔IC7465 IC7320↔CONN.1302	DAI-O interface data
CDAILD	IC7320→IC7465 IC7320→CONN.1302	DAI-O interface mode
CDCEP		CD-Circ Efm Encoder Plus
CDE	IC7170→R3255	CD erase
CE_INT	IC7170←IC7245	CDCEP interrupt
CFLG	IC7210→CONN.1250	Correction flag output(CD60)
CLCE	IC7170→IC7245	µP clock output encoder(CD60)
CLDE	IC7170→IC7210	µP clock output decoder(CD60)
CLDS	IC7170→IC7130	µP clock output DSICR
CLKQ	IC7245→IC7240 IC7245→IC7241	PLL clock output from encoder
CLKQD	IC7241→IC7240	CLKQ divided by 2
CLO3	IC7440→IC7405 IC7440→IC7465 IC7440→IC7480	GDIN clock3 out: system clock for ADC, DAC and DAI-O
CLWP	IC7170→IC7245	µP clock Atip information CDCEP
COMCLK	IC7320↔R3165(IC7170) IC7320↔CONN.1300	Communication clock for data transfer from user microprocessor
COMSYNC	IC7320↔IC7170 IC7320↔CONN.1300	Communication synchronisation from user microprocessor
CRIN	IC7440→IC7210	GDIN clock1 out: system clock for decoder CD60
CSEXP	IC7320→IC7323	Chip Select Expander

CSRAM	IC7320→IC7321	Chip Select RAM
CSROM	IC7320→IC7322	Chip Select ROM
D[0:7]	IC7320↔IC7322 IC7320↔IC7323 IC7320↔IC7324	Data bus
DAC		Digital/Analog Converter
DACE	IC7170→IC7245	µP data I/O CPCEP
DACL	IC7170→CONN.1102	DAC clock
DADE	IC7170→IC7210	uP data CDLIP
DADI	IC7170→CONN.1102	DAC data in (CDM)
DADS	IC7170→IC7130	µP data I/O DSICR
DAI-O		Digital Audio Input/Output
DAIO_REC	IC7325→IC7403	high during recording from digital in source, low to prevent conflict in IIS bus during playback and analog recording
DAIN	IC7245↔IC7480 IC7245↔IC7403 IC7245↔IC7440	Data signal(CDCEP)
DALD	IC7170→CONN.1102	DAC load(CDM)
DAOUT	R3217(IC7210)→IC7403	I^2S data output(CD60)
DAWP	IC7170→IC7245	µP data Atip information(CDCEP)
DC1		Filament voltage for display
DC2		Filament voltage for display
DEEM1	IC7323→IC7480	Deemphasis active(44.1 kHz sample rate)
DIGIN	CONN.1400→IC7440 CONN.1400→C2465	Digital input
DIGOUT	IC7465→CONN.1400	Digital output
DSICR		Digital Servo IC Recordable
E	IC7320→IC7324	E-clock microcontroller
EECL	IC7170→CONN.1102	EEPROM clock
EEDA	IC7170↔CONN.1102	EEPROM data
EFM	IC7245→IC7205	Eight to Fourtheen Modulation CDCEP output for monitoring (reduced voltage from CD60 to MONON)
EFMCLK	IC7245→CONN.1102	EFM clock 4.3218 or 8.6436 MHz
EFMM	IC7245→CONN.1102	EFM N-1
FEN	CONN.1101→IC7130	Focus Error Normalized = (C1 + C3 - C2 - C4)/(C1 + C2 + C3 + C4)
FEOFS	IC7170→R3133	Focus Error OFF Switch
FOC+	IC7105→CONN.1101	Focus actuator positive connection
FOC-	IC7105→CONN.1101	Focus actuator negative connection
FS	CONN.1102→R3152	FS = FS0 - DALFA(write power to laser control)
FSM	CONN.1102→D6155	Focused sense monitor
GDIN		General Digital INput
GDINCL	IC7320→IC7440 IC7320→CONN.1304	GDIN interface clock
GDINDA	IC7320↔IC7440 IC7320↔CONN.1304	GDIN interface data
GDINLD	IC7320→IC7440 IC7320→CONN.1304	GDIN interface mode
HALL_U, V, W	IC7170→IC7270 IC7170→IC7280	Hall element U, V, W of motor
HMSW	CONN.1101→IC7170	Home Switch

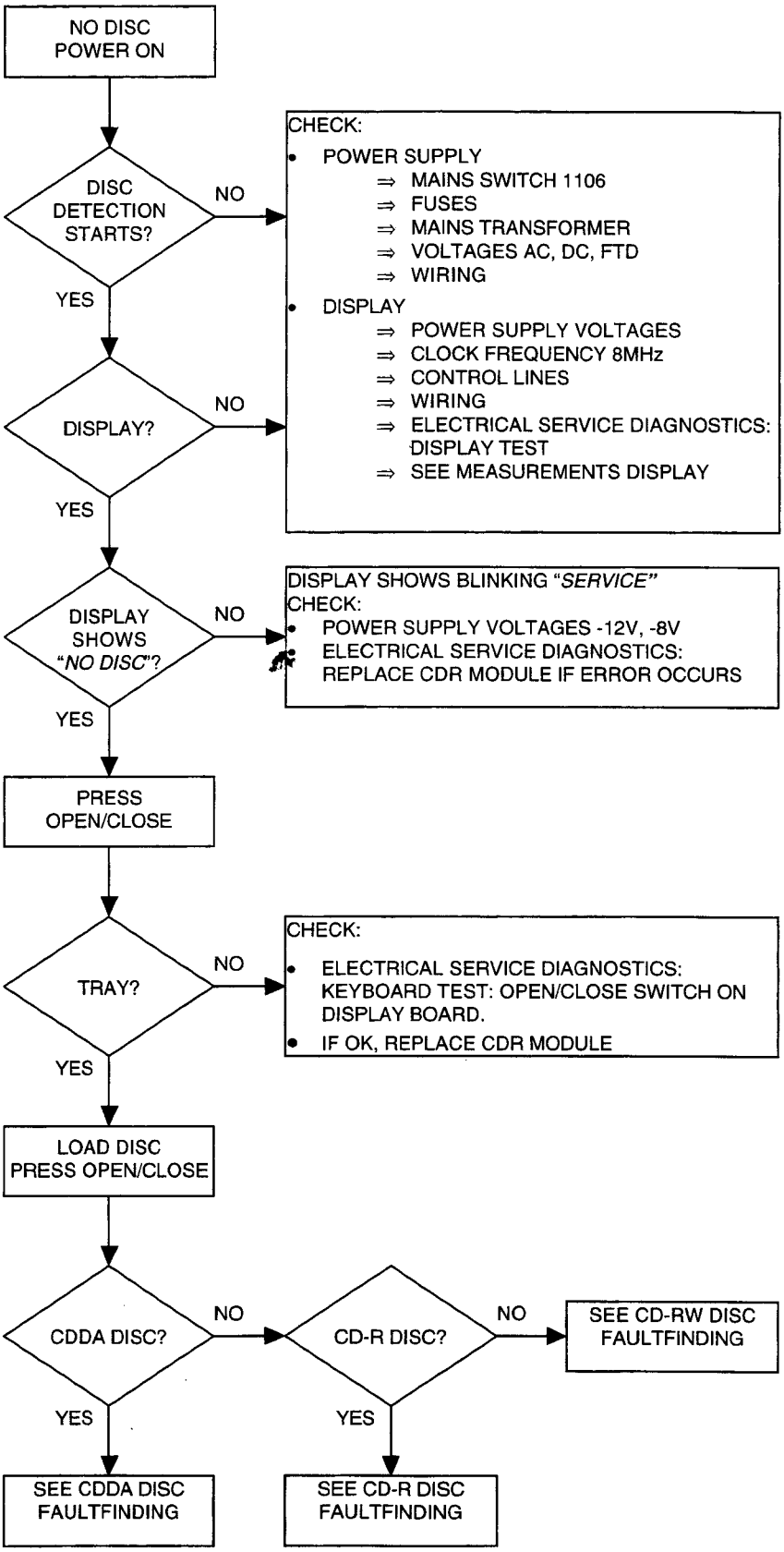
IISCLK	IC7460→IC7405 IC7460→IC7480 IC7460→IC7465 IC7460→IC7440	I^2S-BUS clock
IISDIR	IC7323→IC7403	I^2S-BUS direction, high during playback
IISWS	R3219(IC7210)→IC7403	I^2S-BUS word select
KILL	CONN1430→CONN1420 CONN1430→D6400	Kill signal to mute analog output signal
LDCE	IC7170←IC7245	µP load input(from CDCEP)
LDDE	IC7170→IC7210	µP load output decoder
LDDS	IC7170→IC7130	µP load output DSICR
LDON	IC7130→CONN.1102 IC7105→CONN.1102	Laser Diode ON(on read)
LEFTOUT	C2497→CONN.1400 C2497→CONN.1420 C2497→C2300	Analog left output
LWRT	IC7245→CONN.1102	Laser at writing power
MIRN	CONN.1101→IC7130	Mirror normalized
MISO	IC7320↔R3168(IC7170) IC7320↔CONN.1300	Master in, Slave out: data from Basic Engine to USER.
MONON	IC7170→IC7205	Monitoring EFM from CDCEP to CD60
MOSI	IC7320↔R3903(IC7170) IC7320↔CONN.1300	Master out, Slave in : data from USER to Basic Engine
MOTO1	IC7210→IC7170	Control signal for motor
MPWM	IC7170→IC7245	Motor Pulse Width Modulation
N2	IC7170→IC7240 IC7170→IC7205	N = high(double speed)
N4	IC7170→IC7205	N = high(fourfold speed)
NCLOSE	IC7170→R3196	Tray close
NIRQ	IC7170→IC7245	Interrrupt request wobble processing(CDCEP)
NMUTE	IC7320→IC7480 IC7320→R3496, 3497	Mute signal (active low)
NOPEN	IC7170→R3181	Tray open
NRSMP	IC7245→CONN.1102	None read sample
OPTIN	CONN.1400→IC7440 CONN.1400→IC7465	Optical input
OTD	IC7130→IC7170	Off track dectection DISCR
OVLD	IC7405→IC7320	Overload flag input
PLAY/REC	IC7325→IC7407	high during recording (digital out from DAIO), low during playback (digital out from CD60).
PP	CONN.1101→C2231	XB or PPN(read or write)
PWM	IC7170→R3268	Pulse width modulation
R/W	IC7320→IC7324	µP read/write signal
RAD+	IC7105→CONN.1101	Radial actuator positive connection
RAD-	IC7105→CONN.1101	Radial actuator negative connection
RADINT	IC7170→R3111	Radial actuator integrator voltage.
REN	CONN.1101	Radial Error Normalized

RENSW	IC7170→R3124	Radial Error Normalized switch
RESEN	IC7170→IC7245 IC7170→IC7130	Reset encoder(CDCEP) and digital servo(DSICR)
RESET	IC7170→IC7210	Reset decoder CD60
RIGHTOUT	C2498→CONN.1400 C2498→CONN.1420 C2498→C2303	Analog right output
RSTIN	IC7320→IC7325	Reset microcontroller(from user µP)
RSTHA	IC7325→IC7465	Reset high active, reset for DAIO
RSTLA	IC7325→IC7440 IC7325→R3908 IC7325→D6130 IC7325→CONN.1330	Reset low active, reset for GDIN, servo uP, DSD3, DSICR and display.
RXD	IC7320↔IC7325	Receive data of serial interface
SCL	IC7320↔CONN.1303 IC7320↔L5300	I^2C-bus clock for communication
SDA	IC7320↔CONN.1303 IC7320↔L5300	I^2C-bus data to display driver
SDAUX	IC7405→IC7440	Analog to digital converted data from ADC to DAI-O
SL+	IC7105→CONN.1101	Sledge motor positive connection
SL-	IC7105→CONN.1101	Sledge motor negative connection
STROBE	IC7320→IC7465 IC7320→CONN.1302	Control signal for DAI-O : data strobe
SWRT	IC7245→CONN.1102	Start Write 9ms(one shot at start up LWRT)
SYSSYNC	IC7170→CONN.1135	System synchronization
TLN	CONN.1101→IC7130	Track Loss Normalized
TRS1N	IC7170→CONN.1103	Tray sense
TXD	IC7320↔IC7325	Transmit data serial interface
UDAVAIL	IC7320→IC7465	User-data available
UNLOCK	IC7465→IC7320	Not locked on incoming EBU-signal
UNLOCK_GDIN	IC7323→R3435	Unlock signal to GDIN
V4	IC7210→CONN.1250	Versatile pin 4
VFTD		Power supply for display
WCLK	IC7210→IC7245	Word clock

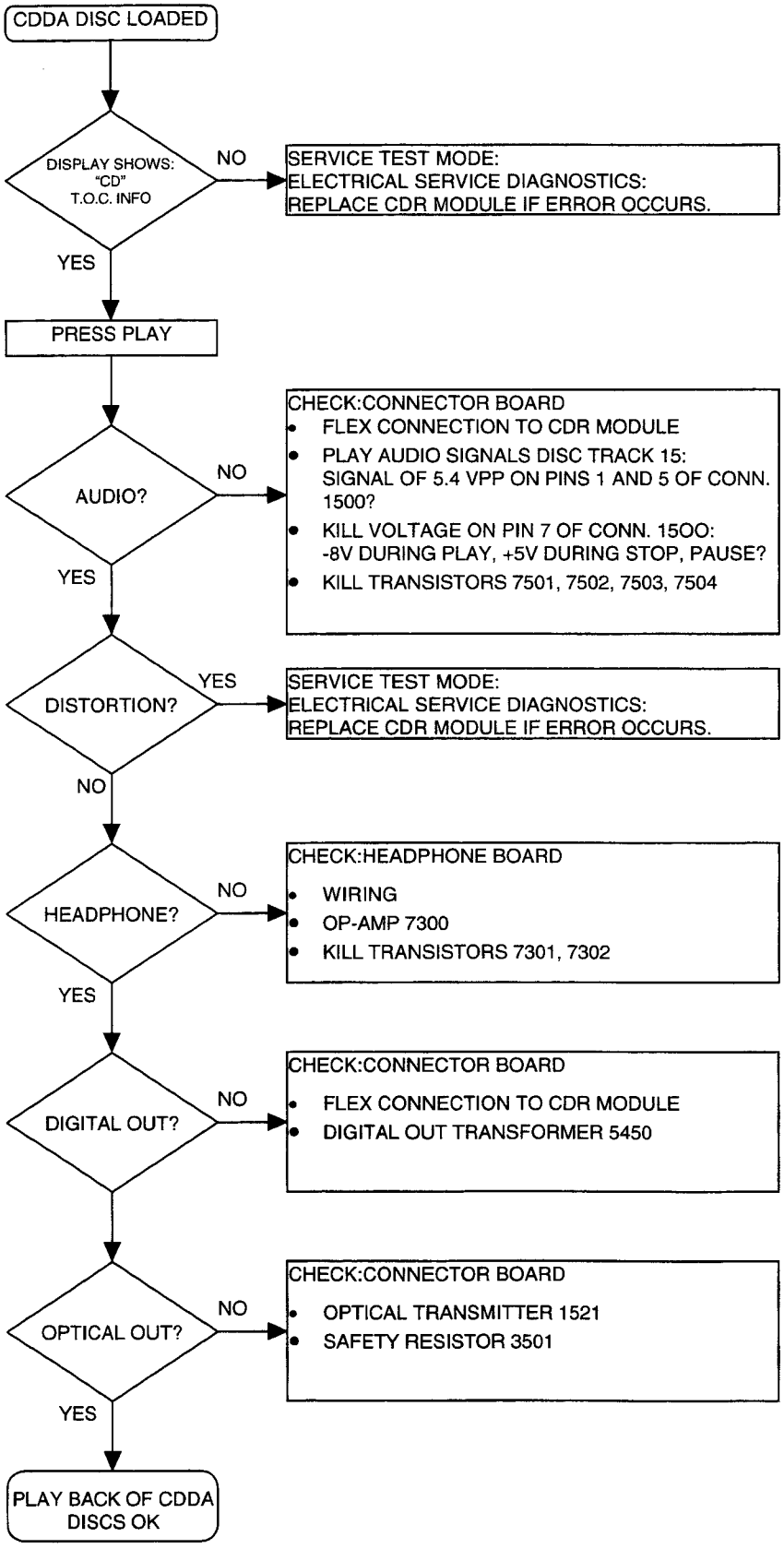
SERVICE TEST PROGRAM


If power ON, switch power OFF
DEALER DIAGNOSTICS (status of player) Press<PLAY> + <STOP> simultaneously and switch power on
Display shows blinking: "BUSY" during the test.
Set OK?
no
set displays: "ERROR"
yes
set displays: "PASSED"
to end test, switch power off
ELECTRICAL SERVICE DIAGNOSTICS (advice for replacement units) Load CDDA disc(SBC444A) Press<PLAY> + <NEXT> simultaneously and switch power on
MAIN BOARD TEST Display shows blinking "D -----" during the test
Test OK?
no
set displays: "DERR n"
n =
1 : RAM test error
2 : ROM test error
3 : EEPROM test error
4 : PANIO test error
5 : GDIN test error
yes
<NEXT>
BASIC ENGINE TEST Display shows "B -----" during the test
Test OK?
no
set displays: "BERR n"
n =
1 : Communication bus error
2 : Basic Engine self test error
3 : Disc test error
yes
<NEXT>
DISPLAY TEST
All segments are blinking at a frequency of 1Hz.
<NEXT>
KEYBOARD/REMOTE TEST
Display shows name of pressed key on keyboard or remote control.
To end test, switch power off.
DC ERASE (erasement of complete disc) Load CD-RW disc Press <ERASE> + <RECORD> simultaneously and switch power on
Display shows: "ER mm:ss" during the erase function.
mm :remaining minutes
ss :remaining seconds
TOTAL and REM are also illuminated
Display shows: "PASSED" when the erase function is completed.
switch power off.

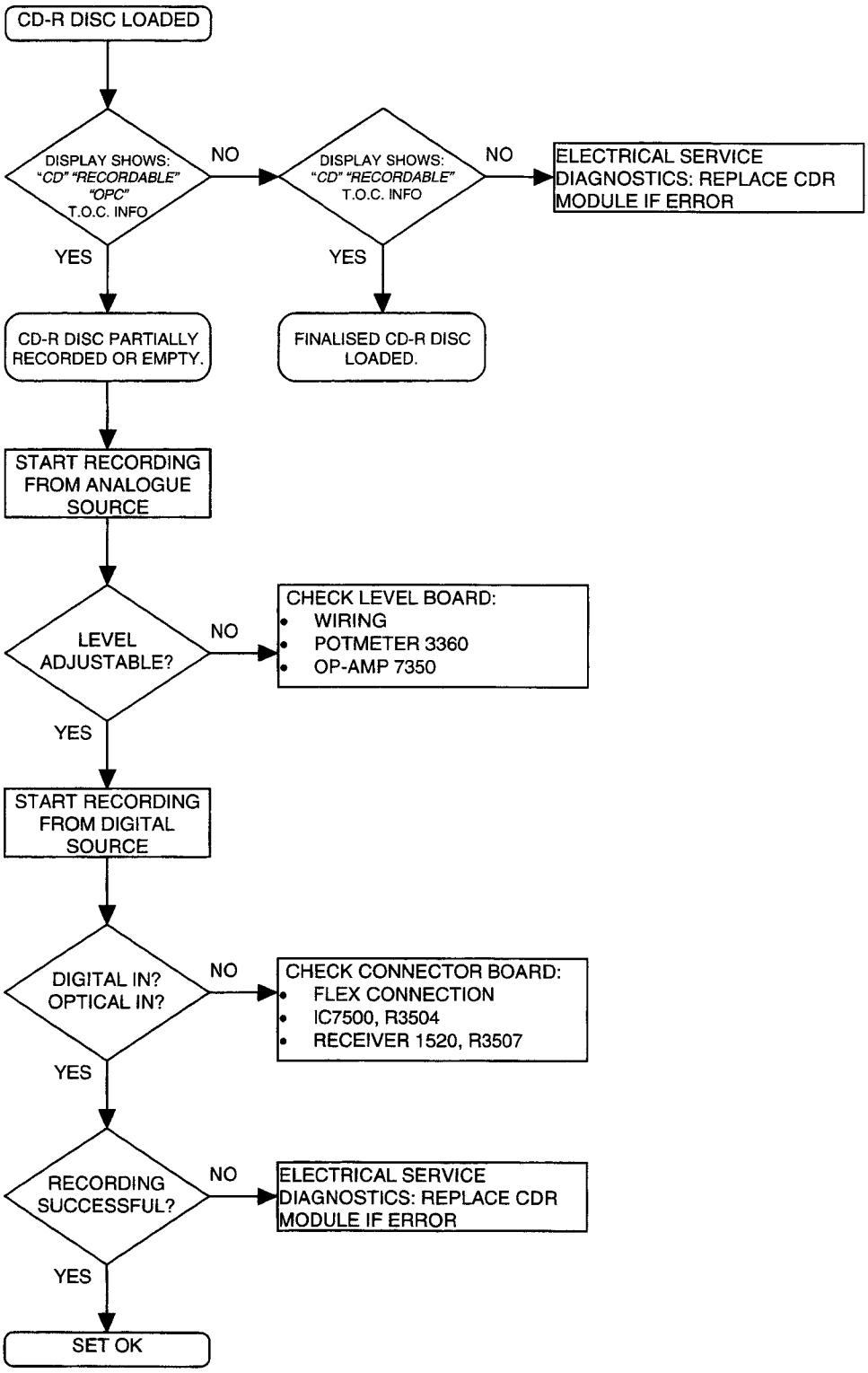
FAULTFINDING GUIDE



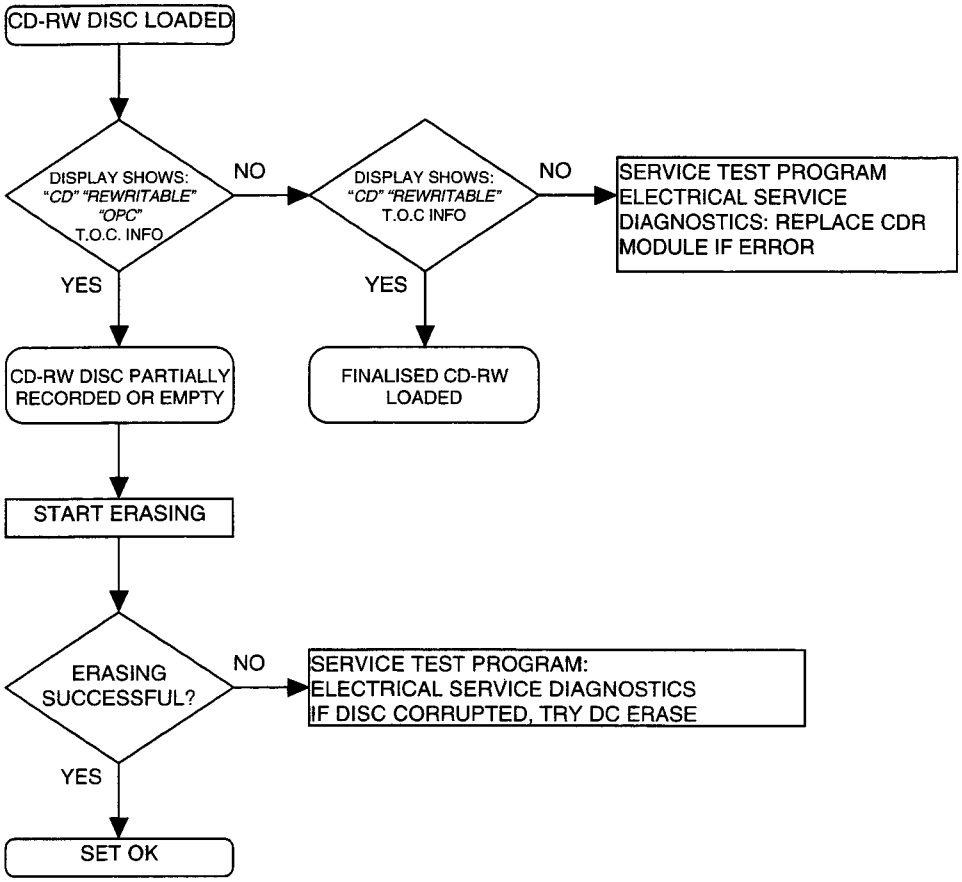
CDDA DISC FAULTFINDING GUIDE



CD-R DISC FAULTFINDING



CD-RW DISC FAULTFINDING



MEASUREMENTS DISPLAY PANEL

1. Measurement of voltage supplies.

Several voltages arrive at the display PCB.
Measurements and limits.

Voltage	Nominal value	Limits
VFTD	-26V	±5%
VDC1-DC2	3.5V	±10%
Vb	5V	±5%

2. Measurement of oscillator.

As clock driver for the display controller a resonator of 8Mhz is used.
The clock frequency is available at pin 8 of the display controller.
Check the frequency of 8Mhz ±5%.

3. Checking the control lines.

There are several lines which are inputs to the display controller and others which are outputs, these lines have to be checked to guarantee basic functionality.

RESETN:

This line should be kept low during power up for at least 3 machine cycles,with supply voltage within the operating range and oscillation stable.1 machine cycle = 12 X 1/Fc (8Mhz) Sec.

SDA and SCL:

The level on these two lines must be checked. When there is no communication they should have the 'High' level.

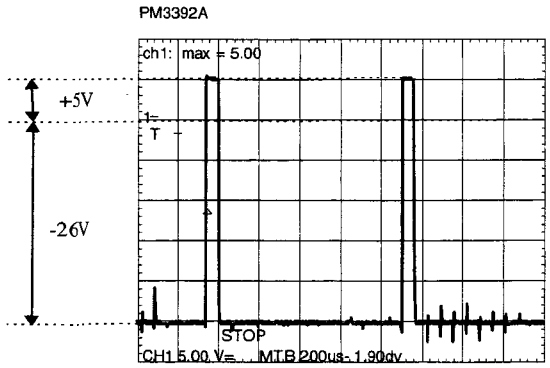
INTERRUPT:

The interrupt line is an output for the display controller. Check if this level is high after reset, no key pressed and no RC5 coming in.

Key matrix lines:

Check if at I/O port 4 of the controller all pins are high.(No keys pressed).(Pin 26 to 33). If not check respective pull-up resistors.

4. Operation of grid and segment control lines.



This figure shows the signal generated by the display processor on one of the grid lines. The level on the grid line changes from -26V to +5V.

The grid lines are scanned successively about every 950 µsec.

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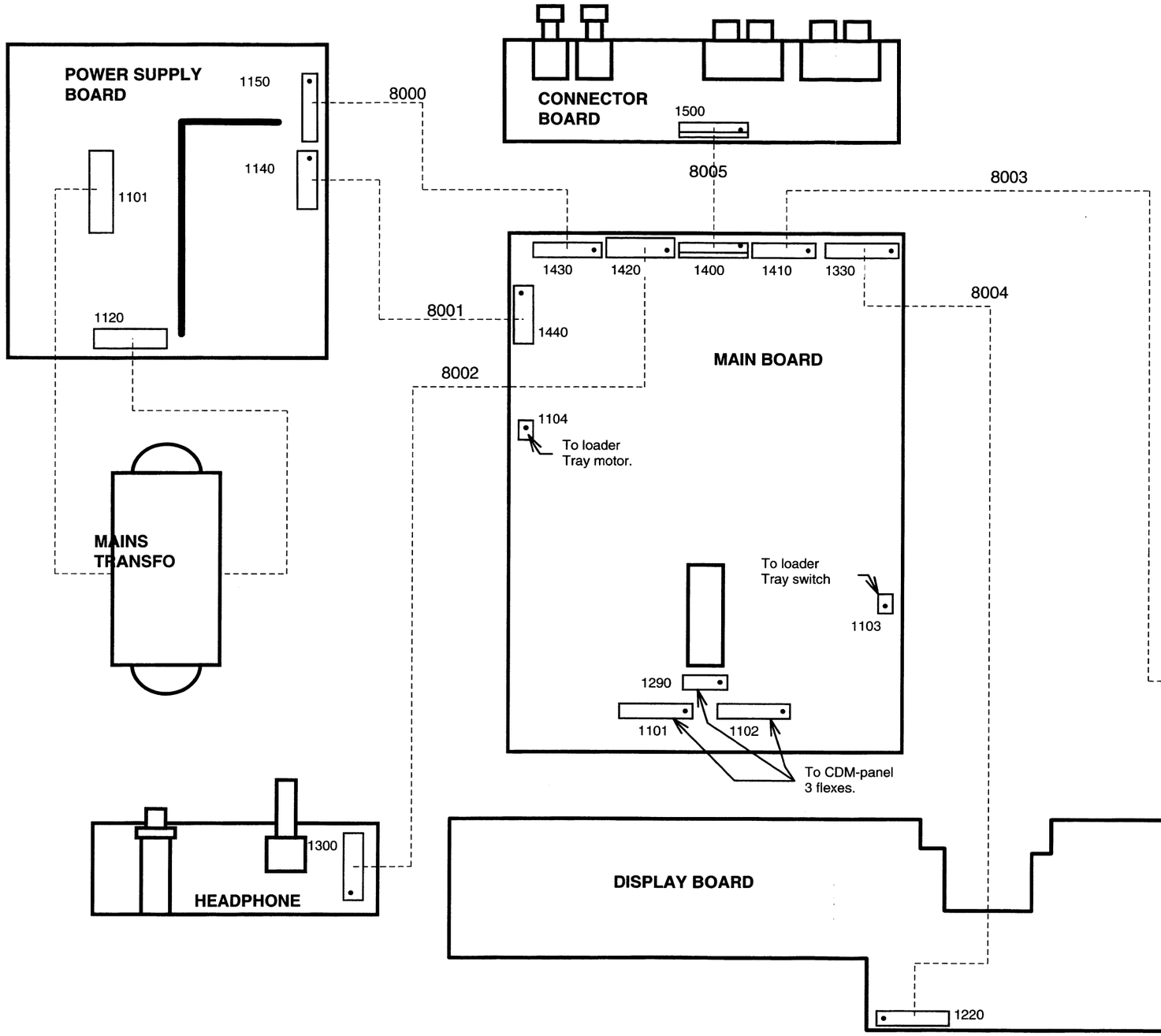
WIRING DIAGRAM



Pin 1 indicated by • All Wires are one to one connected

8000

1	DC2!
2	DC1!
3	VFTD!
4	GROUND
5	+5Va!
6	GROUND
7	+12Vb!
8	-12Vb!
9	GROUND
10	KILL!

8001

1	+5Vb!
2	+5VM!
3	GROUND
4	-8V!
5	+12Va!
6	GROUND

8002

1	LEFTOUT!
2	GROUND
3	RIGHTOUT!
4	KILL!
5	-12Vb!
6	GROUND
7	+12Vb!

8003

1	LEFTFLEV!
2	GROUND
3	RIGHTFLEV!
4	-12Vb!
5	GROUND
6	+12Vb!
7	RIGHTTLEV!
8	GROUND
9	LEFTTLEV!

8004

1	SDA!
2	SCL!
3	RSTIN!
4	GROUND
5	Interrupt!
6	GROUND
7	VFTD!
8	DC2!
9	DC1!
10	GROUND
11	+5Vb!

8005

1	RIGHTOUT!
2	GROUND
3	GROUND
4	LEFTIN!
5	LEFTOUT!
6	GROUND
7	KILLBUF!
8	RIGHTIN!
9	+5Vb!
10	DIGIN!
11	GROUND
12	DIGOUT!
13	GROUND
14	OPTIN!
15	GROUND
16	GROUND

HAS1182
9735

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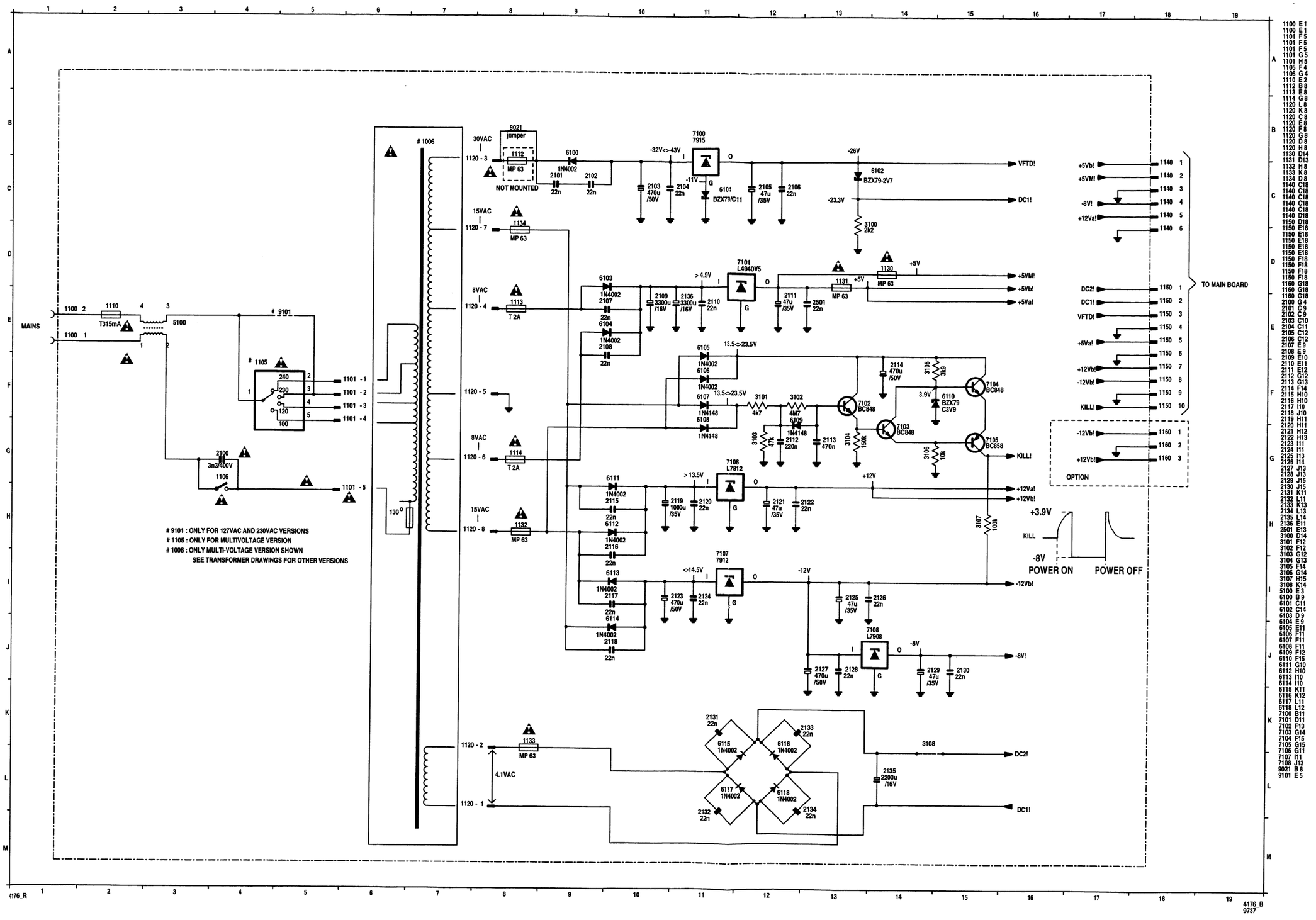
POWER SUPPLY CIRCUIT DIAGRAM



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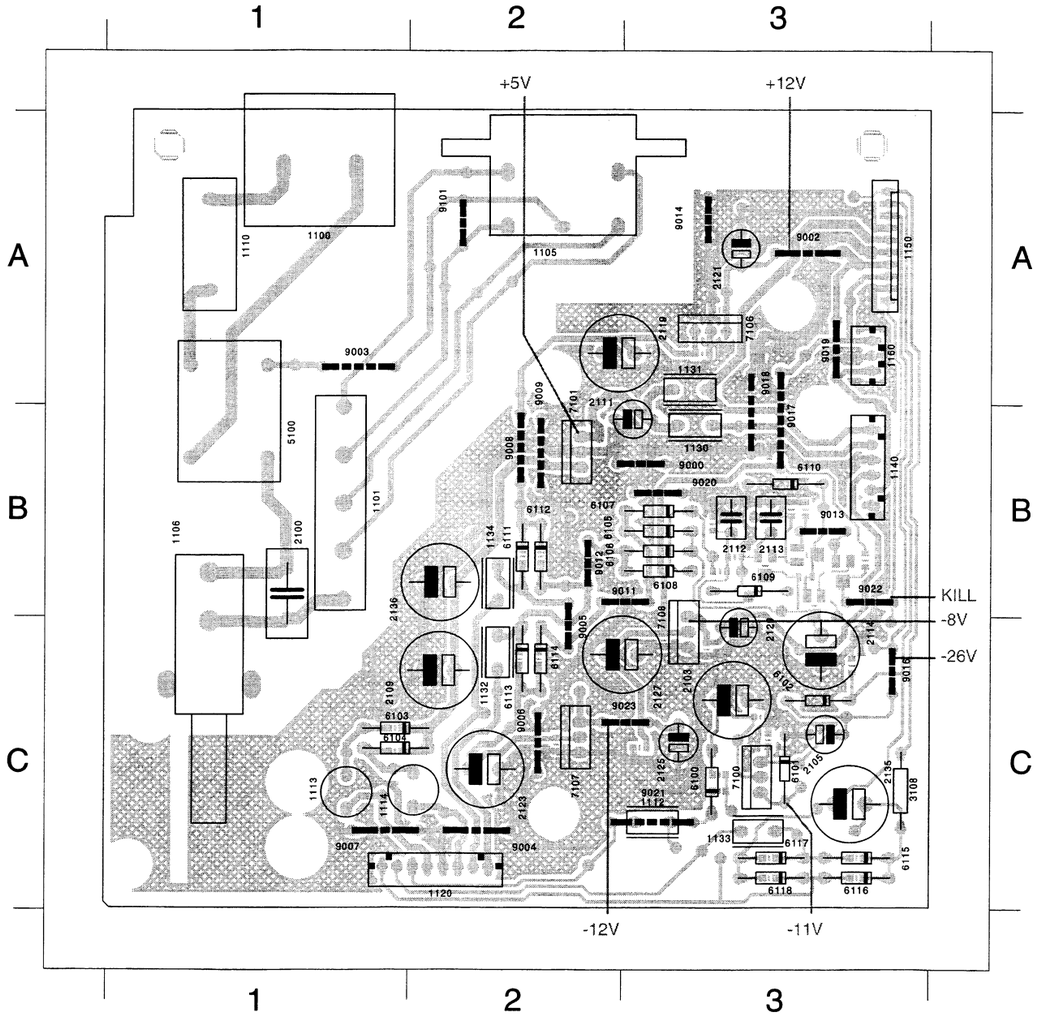
POWER SUPPLY BOARD

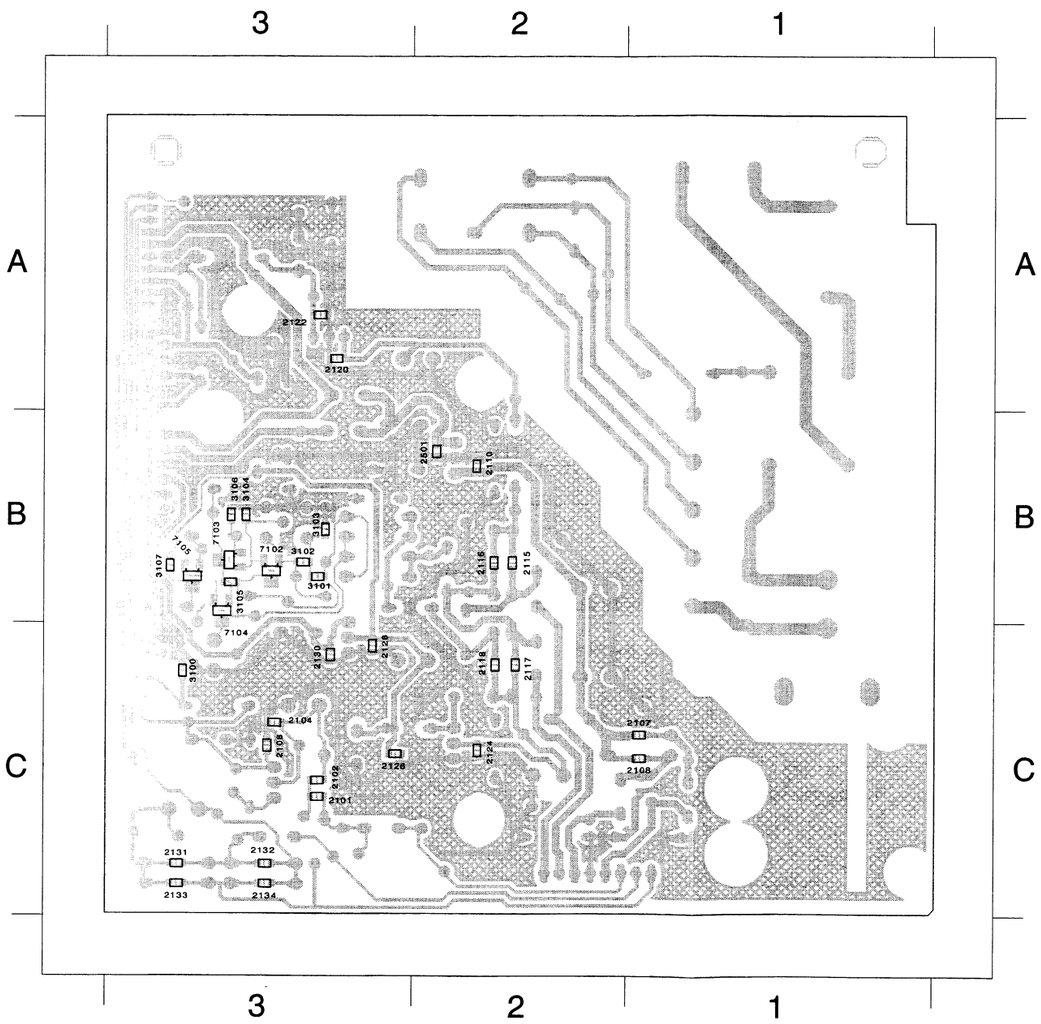
COMPONE NT SIDE

1100 A 1 1114 C 2 1140 B 3 2111 B 3 2125 C 3 6100 C 3 6107 B 3 6114 C 2 7106 A 3 9005 C 2 9013 B 3 9021 C 3
1101 B 1 1120 C 2 1150 A 3 2112 B 3 2127 C 2 6101 C 3 6108 B 3 6115 C 3 7107 C 2 9006 C 2 9014 A 3 9022 B 3
1105 A 2 1130 B 3 1160 A 3 2113 B 3 2129 C 3 6102 C 3 6109 B 3 6116 C 3 7108 C 3 9007 C 1 9016 C 3 9023 C 3
1106 C 1 1131 A 3 2100 B 1 2114 C 3 2135 C 3 6103 C 1 6110 B 3 6117 C 3 9000 B 3 9008 B 2 9017 B 3 9101 A 2
1110 A 1 1132 C 2 2103 C 3 2119 A 2 2136 B 2 6104 C 1 6111 B 2 6118 C 3 9002 A 3 9009 B 2 9018 B 3
1112 C 3 1133 C 3 2105 C 3 2121 A 3 3108 C 3 6105 B 3 6112 B 2 7100 C 3 9003 A 1 9011 B 3 9019 A 3
1113 C 1 1134 B 2 2109 C 2 2123 C 2 5100 B 1 6106 B 3 6113 C 2 7101 B 2 9004 C 2 9012 B 2 9020 B 3



SOLDER SIDE

2101 C 3 2106 C 3 2110 B 2 2117 C 2 2122 A 3 2128 C 3 2132 C 3 2501 B 2 3102 B 3 3105 B 3 7102 B 3 7105 B 3
2102 C 3 2107 C 1 2115 B 2 2118 C 2 2124 C 2 2130 C 3 2133 C 3 3100 C 3 3103 B 3 3106 B 3 7103 B 3
2104 C 3 2108 C 1 2116 B 2 2120 A 3 2126 C 3 2131 C 3 2134 C 3 3101 B 3 3104 B 3 3107 B 3 7104 B 3

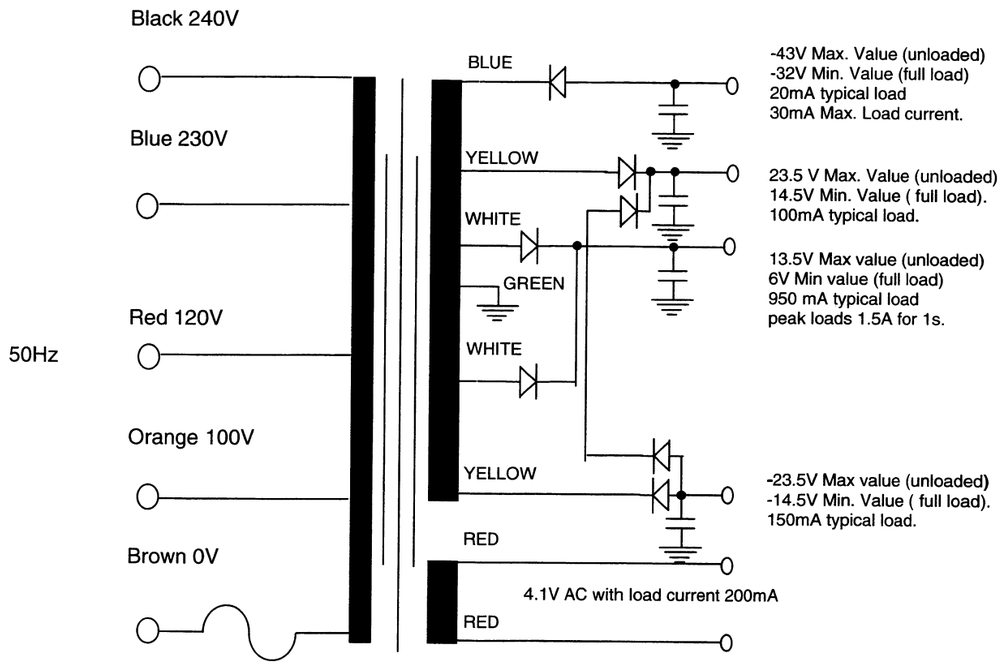


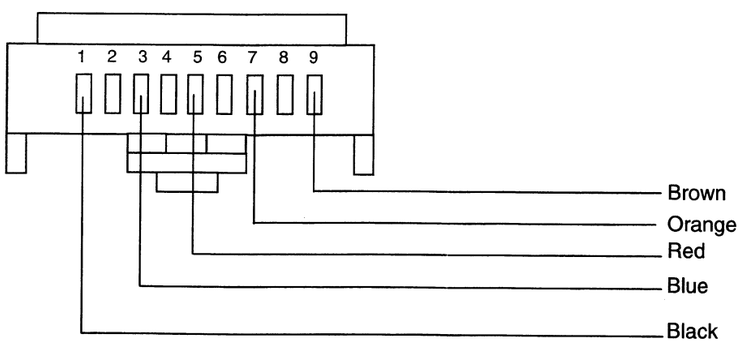
Description of Mains Transformers

/11 Version: Multivoltage version

Note: All values measured with scope. Minimum value is DC voltage minus ripple.

Primary voltages ±10%





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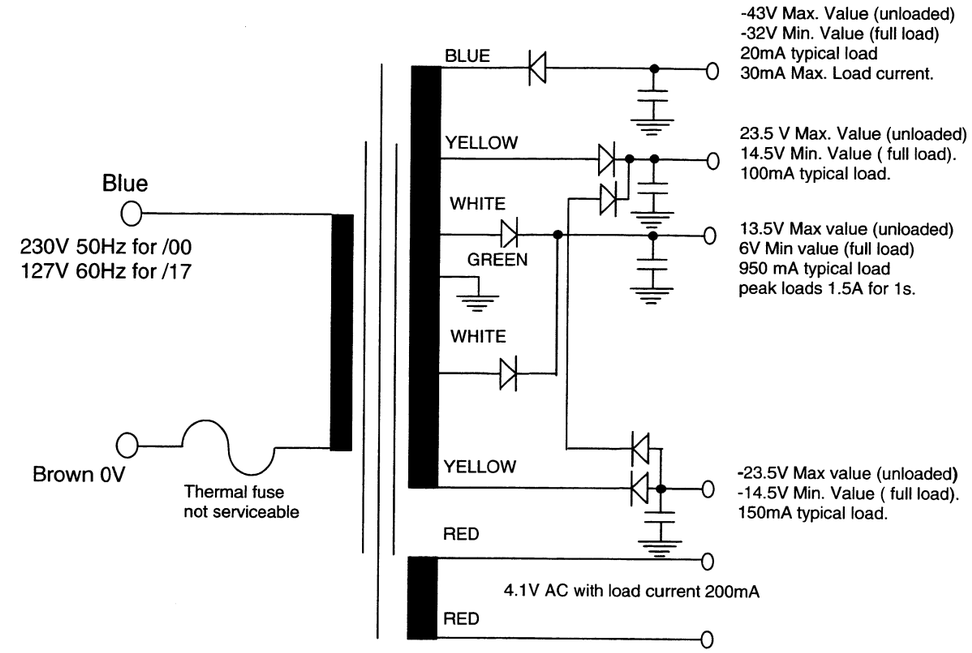
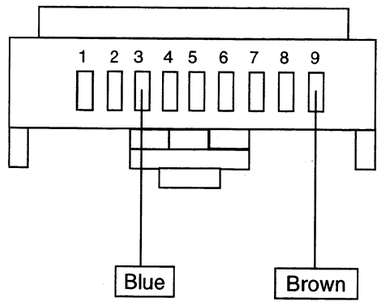
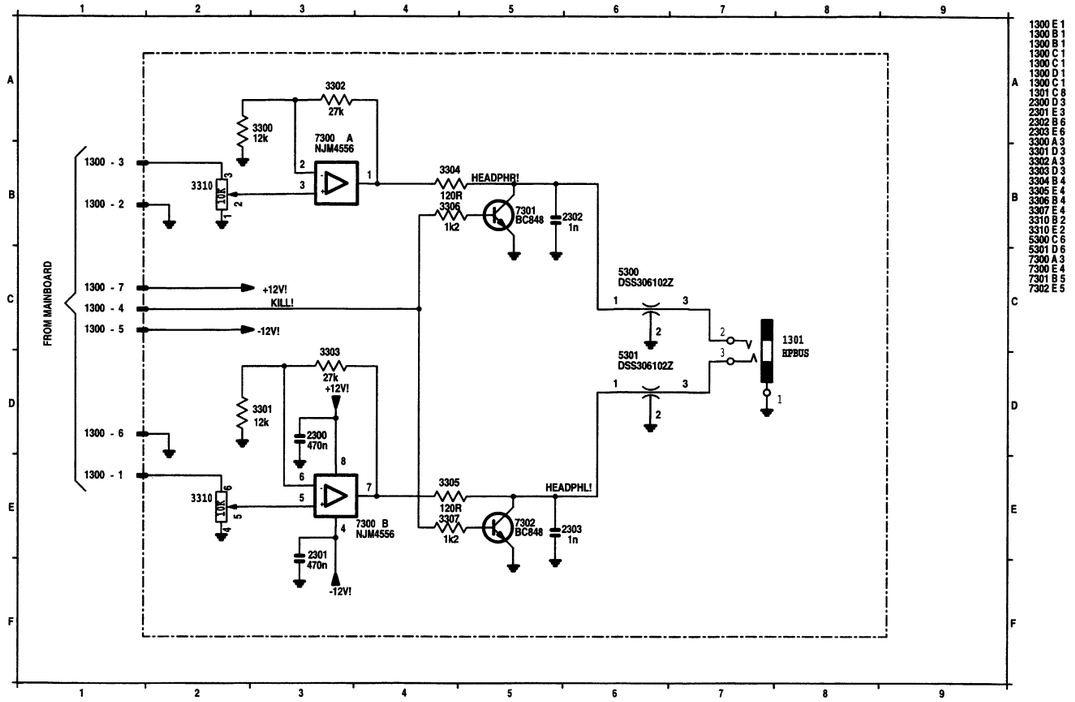
/00 version(230V) & /17 version(127V)



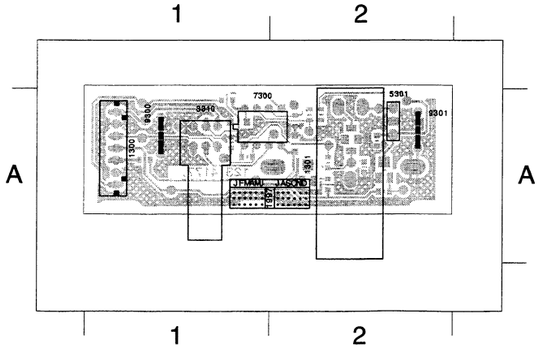


HEADPHONE CIRCUIT DIAGRAM

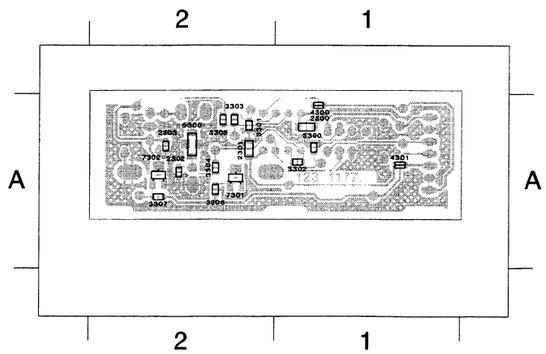


HEADPHONE BOARD

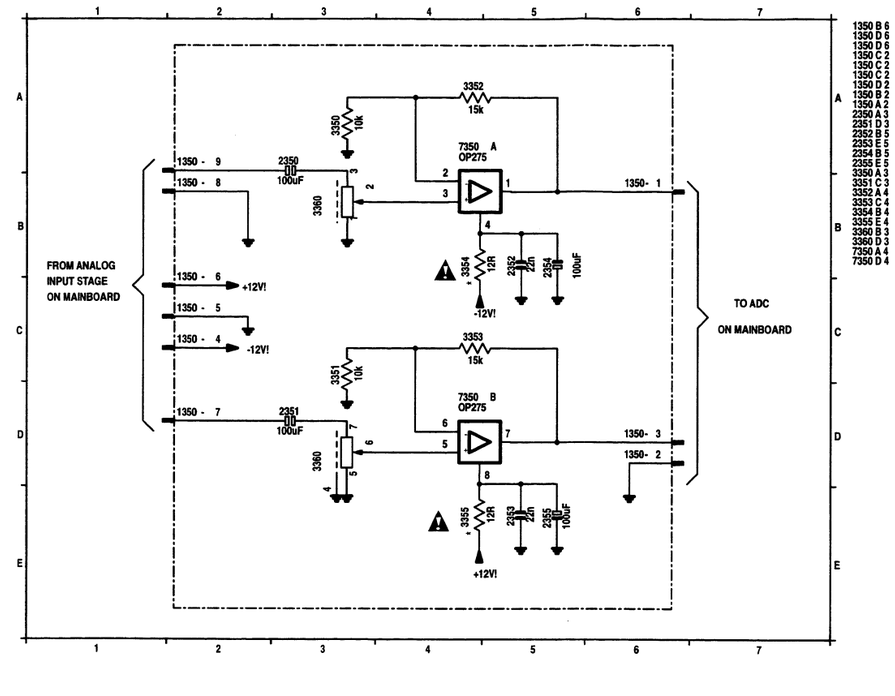
1300 A 1 1301 A 2 3310 A 1 5301 A 2 7300 A 1 9300 A 1 9301 A 2



2300 A 1 2303 A 2 3302 A 1 3305 A 2 4300 A 1 7301 A 2
2301 A 2 3300 A 1 3303 A 2 3306 A 2 4301 A 1 7302 A 2
2302 A 2 3301 A 2 3304 A 2 3307 A 2 5300 A 2

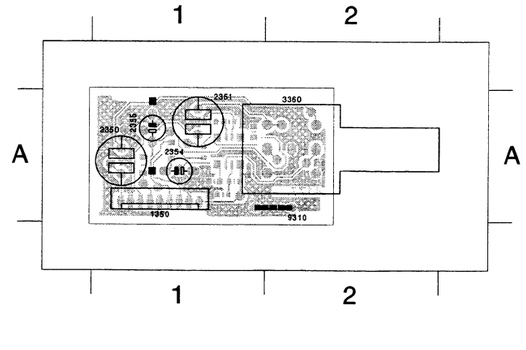


LEVEL CIRCUIT DIAGRAM

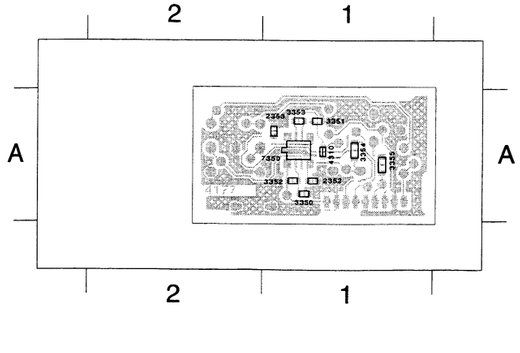


LEVEL BOARD

1350 A 1 2350 A 1 2351 A 1 2354 A 1 2355 A 1 3360 A 2 9310 A 2



4310 A 1 3354 A 1 3352 A 1 3350 A 1 2352 A 1
7350 A 1 3355 A 1 3353 A 1 3351 A 1 2353 A 1



DISPLAY & CONTROL CIRCUIT DIAGRAM

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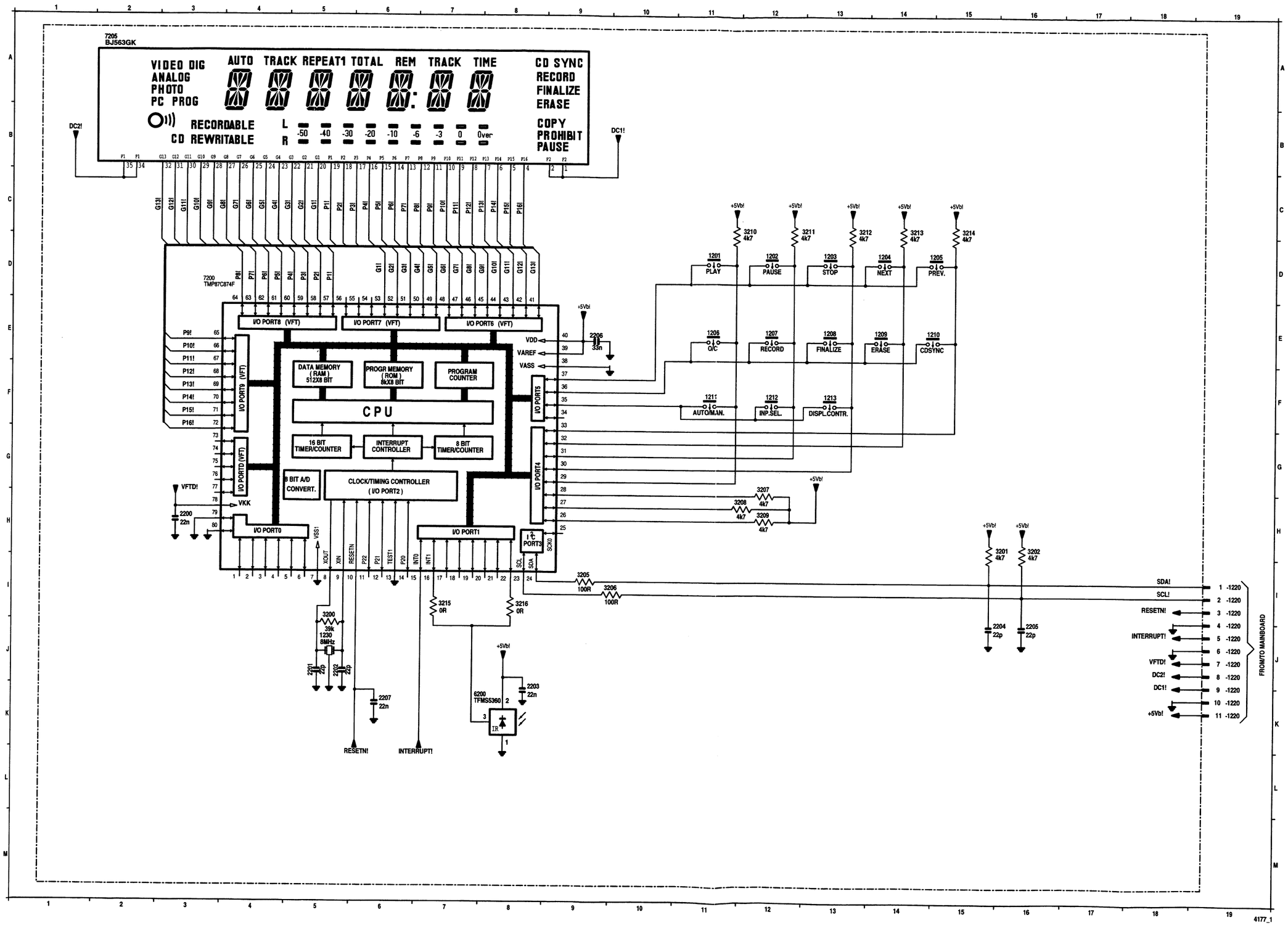

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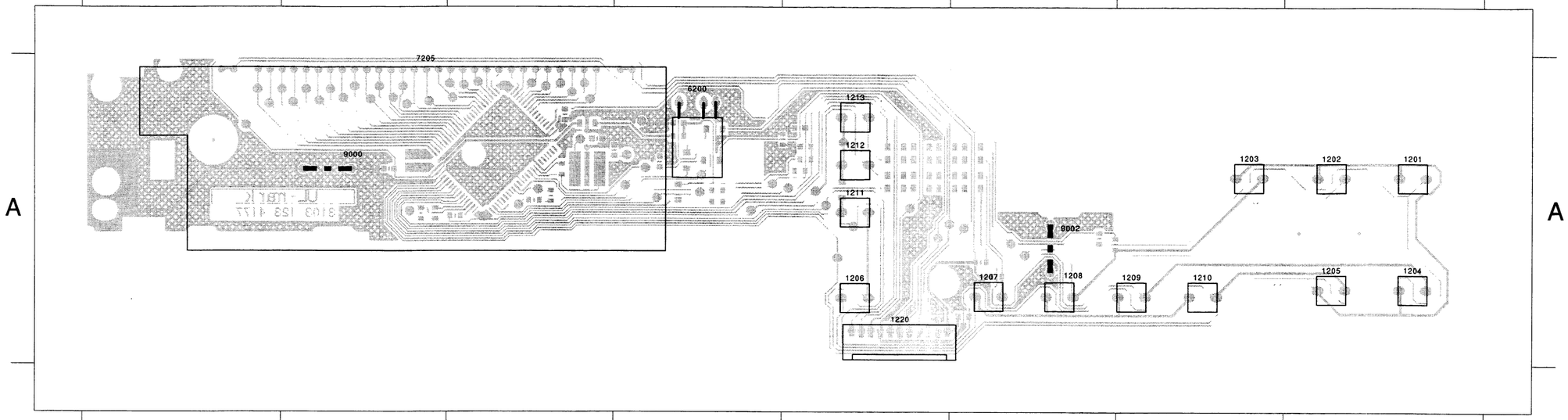
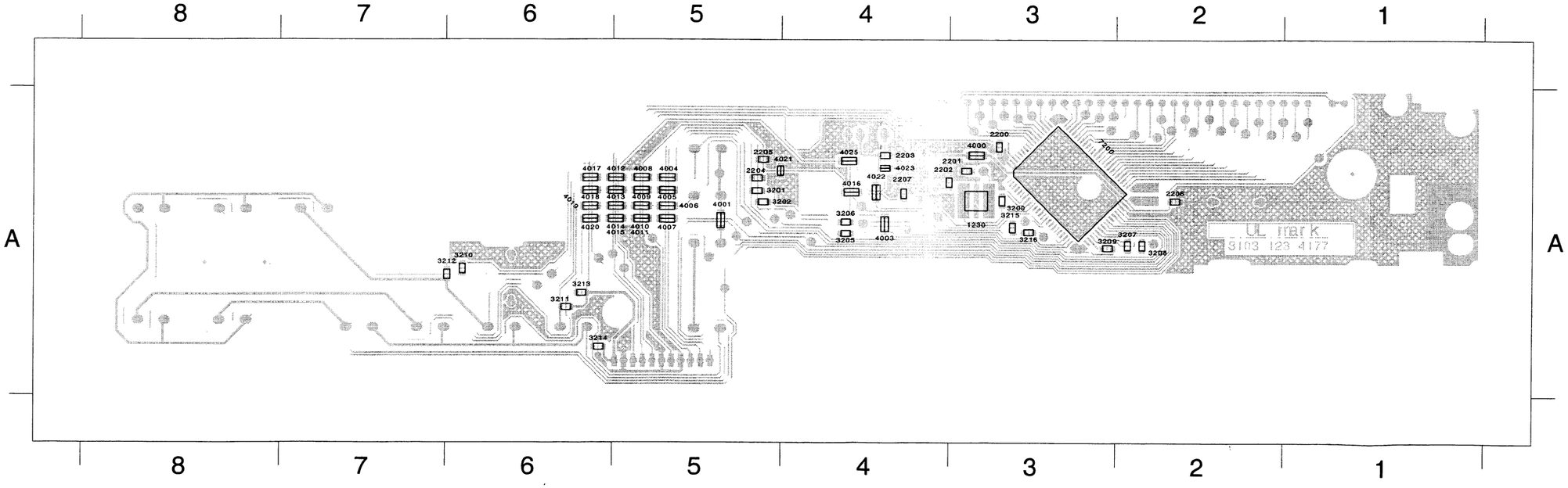
DISPLAY BOARD

1201 A 8 1202 A 8 1203 A 7 1204 A 8 1205 A 8 1206 A 5 1207 A 6 1208 A 6 1209 A 7 1210 A 7 1211 A 5 1212 A 5 1213 A 5 1220 A 5 6200 A 4 7205 A 2 9000 A 2 9002 A 6

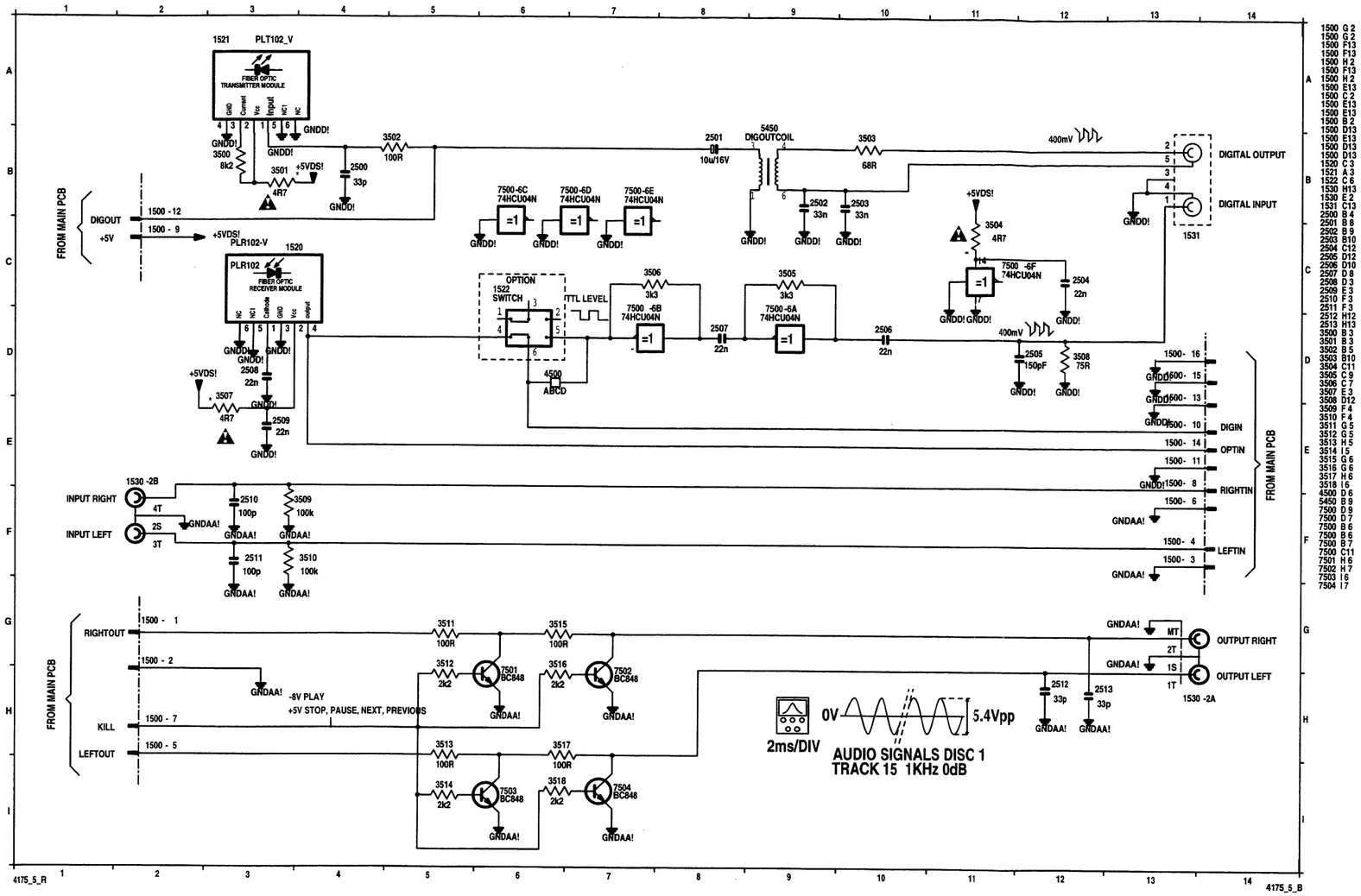


1230 A 3 2201 A 3 2203 A 4 2205 A 5 2207 A 4 3201 A 5 3205 A 4 3207 A 2 3209 A 3 3211 A 6 3213 A 6 3215 A 3 4000 A 3 4003 A 4 4005 A 5 4007 A 5 4009 A 5 4011 A 5 4013 A 5 4015 A 5 4017 A 6 4019 A 6 4021 A 5 4023 A 4 7200 A 3
2200 A 3 2202 A 4 2204 A 5 2206 A 2 3200 A 3 3202 A 5 3206 A 4 3208 A 2 3210 A 6 3212 A 6 3214 A 6 3216 A 3 4001 A 5 4004 A 5 4006 A 5 4008 A 5 4010 A 5 4012 A 5 4014 A 5 4016 A 4 4018 A 6 4020 A 6 4022 A 4 4025 A 4



32

CONNECTOR BOARD



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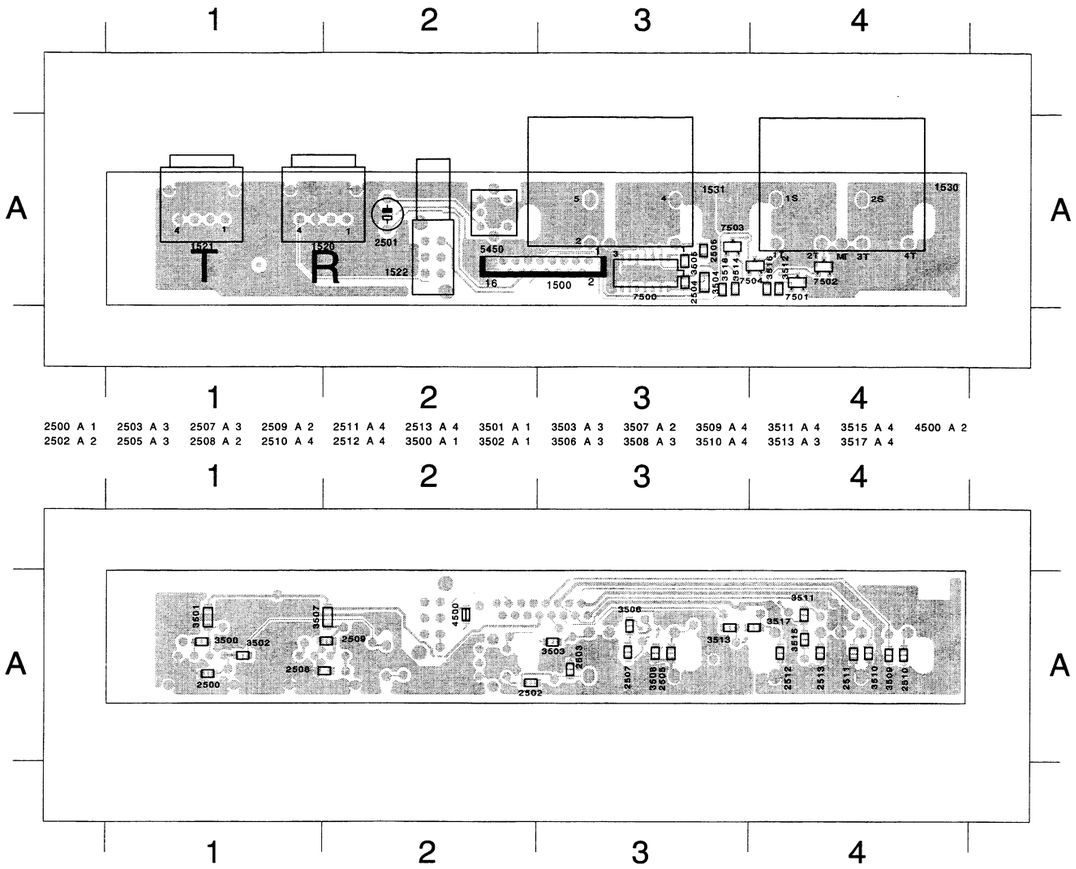
CONNECTOR BOARD

1500 A 3 1521 A 1 1530 A 4 2501 A 2 2506 A 3 3505 A 3 3514 A 3 3518 A 3 7500 A 3 7502 A 4 7504 A 4
1520 A 1 1522 A 2 1531 A 3 2504 A 3 3504 A 3 3512 A 4 3516 A 4 5450 A 2 7501 A 4 7503 A 3



2500 A 1 2503 A 3 2507 A 3 2509 A 2 2511 A 4 2513 A 4 3501 A 1 3503 A 3 3507 A 2 3509 A 4 3511 A 4 3515 A 4 4500 A 2
2502 A 2 2505 A 3 2508 A 2 2510 A 4 2512 A 4 3500 A 1 3502 A 1 3506 A 3 3508 A 3 3510 A 4 3513 A 3 3517 A 4

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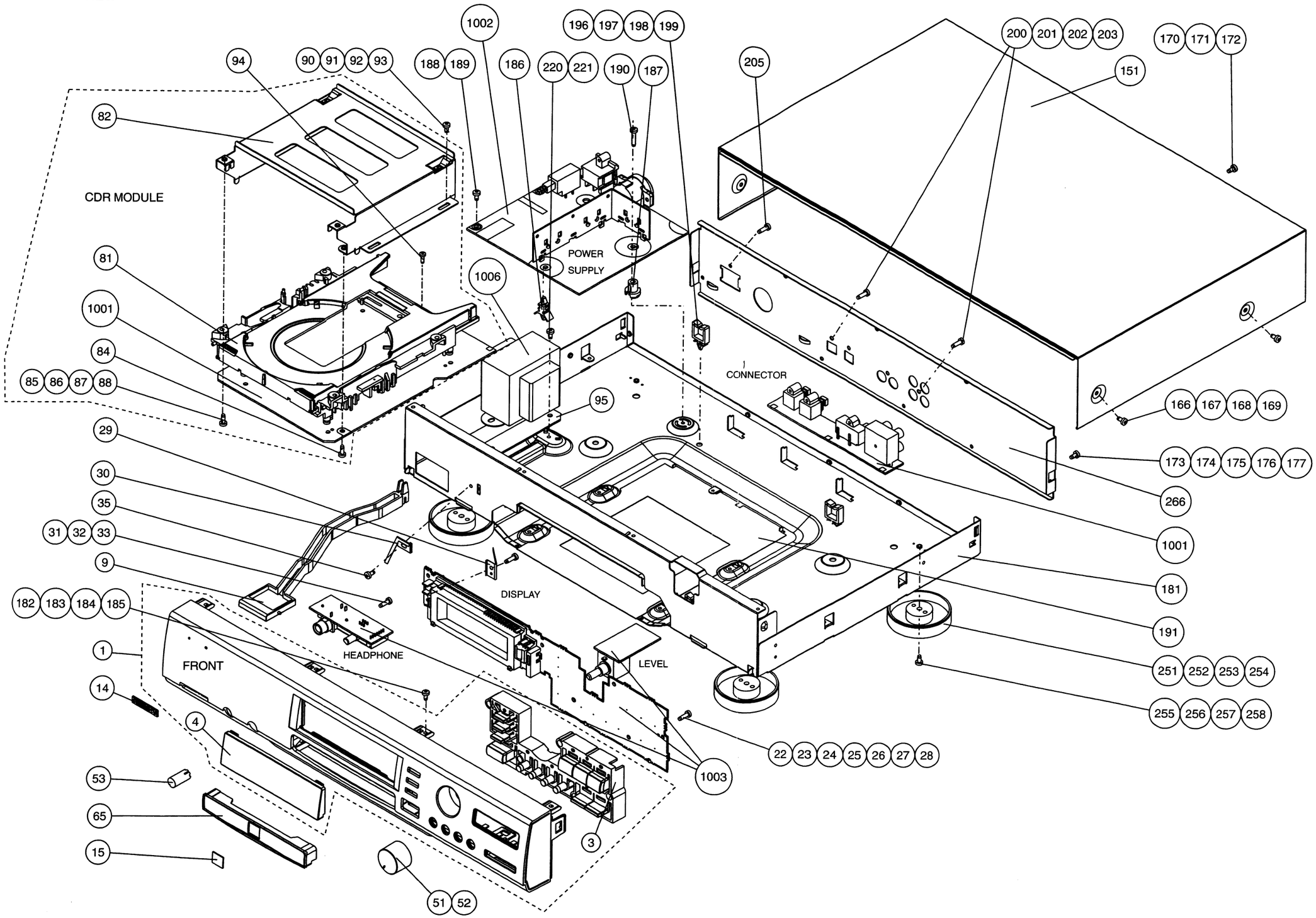
EXPLODED VIEW



MECHANICAL PARTSLIST

1	4822 459 04746	FRONT ASSY COMPLETE
9	4822 532 12871	POWER ROD
14	4822 459 10887	WORDMARK
51	4822 410 11402	REC.LEVEL-KNOB ASSY
52	4822 492 51374	SPRING
53	4822 410 10284	VOLUME KNOB
65	4822 418 10288	TRAY FRONT ASSY
151	4822 442 01095	COVER
251 → 254	4822 462 42159	FOOT SILVER
301	4822 321 10249	SBC1201 MAINSCORD EUROPE
301	4822 321 10445	MAINSCORD JAPAN 125V
301	4822 321 10939	MAINS CORD USA
312	4822 321 11357	AUDIO CORD SET
313	4822 321 11357	AUDIO CORD SET
317	4822 321 61274	DIGITAL OUT CABLE
318	4822 219 10364	REMOTE CONTROL RC7925/01
81 + 82 + 1001	4822 691 10644	CDR LOADER ASSY

Not mentioned parts are only available during production period on special request.

SCREWS

DESCRIPTION	MEASURE	ITEM NUMBERS	FIXATION
selftapper with washer	M2,5 X 6	94	main PCB → frame
	3 X 6	220 →221	trafo → frame
selftapper for metal	M3 X 6	35	earth spring → frame
		84	main PCB → bracket
		85 → 88	loader → loader bracket
		90 → 93	loader bracket → frame
		166 → 177	cover → frame
		182 → 185	front → frame
		188 → 189	supply PCB → frame
		255 → 258	foot → frame
selftapper for plastic	3 X 10	22→28	display → front
		31 →33	headphone → front
		97 → 100	main PCB → loader
		200 → 203	cinches → backplate
		205	mains inlet → backplate

ELECTRICAL PARTSLIST

POWER SUPPLY BOARD

MISCELLANEOUS

	4822 492 63076	SPRING CLIP
1100	4822 265 31015	MAINS INLET
1105 ⚠	4822 277 11483	VOLTAGE SELECTOR (/11)
1106 ⚠	4822 276 13224	MAINS SWITCH
1109 ⚠	4822 256 30274	FUSE HOLDER
1110 ⚠	4822 070 33151	FUSE 315mA
1130 ⚠	4822 252 51185	FUSE 630mA
1131 ⚠	4822 252 51185	FUSE 630mA
1132 ⚠	4822 252 51185	FUSE 630mA
1133 ⚠	4822 252 51185	FUSE 630mA

CAPACITORS

2100 ⚠	4822 126 10454	3,3nF20% 400V
2101	5322 122 32654	22nF10%X7R 63V
2102	5322 122 32654	22nF10%X7R 63V
2103	4822 124 41184	470µF20% 50V
2104	5322 122 32654	22nF10%X7R 63V
2105	4822 124 22427	47µF20% 40V
2106	5322 122 32654	22nF10%X7R 63V
2107	5322 122 32654	22nF10%X7R 63V
2108	5322 122 32654	22nF10%X7R 63V
2109	4822 124 12055	3300µF 20% 16V
2110	5322 122 32654	22nF10%X7R 63V
2111	4822 124 22427	47µF20% 40V
2112	4822 121 42408	220nF 5% 63V
2113	4822 121 51252	470nF 5% 63V
2114	4822 124 41184	470µF20% 50V
2115	5322 122 32654	22nF10%X7R 63V
2116	5322 122 32654	22nF10%X7R 63V
2117	5322 122 32654	22nF10%X7R 63V
2118	5322 122 32654	22nF10%X7R 63V
2119	4822 124 12056	1000µF 20% 35V
2120	5322 122 32654	22nF10%X7R 63V
2121	4822 124 22427	47µF20% 40V
2122	5322 122 32654	22nF10%X7R 63V
2123	4822 124 41184	470µF20% 50V
2124	5322 122 32654	22nF10%X7R 63V
2125	4822 124 22427	47µF20% 40V
2126	5322 122 32654	22nF10%X7R 63V
2127	4822 124 41184	470µF20% 50V
2128	5322 122 32654	22nF10%X7R 63V
2129	4822 124 22427	47µF20% 40V
2130	5322 122 32654	22nF10%X7R 63V
2131	5322 122 32654	22nF10%X7R 63V
2132	5322 122 32654	22nF10%X7R 63V
2133	5322 122 32654	22nF10%X7R 63V
2134	5322 122 32654	22nF10%X7R 63V
2135	4822 124 80148	2200µF20% 16V
2136	4822 124 12055	3300µF 20% 16V
2501	5322 122 32654	22nF10%X7R 63V

RESISTORS

3100	4822 117 11449	2k2 1% 0,1W
3101	4822 051 20472	4k7 5% 0,1W
3102	4822 051 20475	4M7 5% 0,1W
3103	4822 117 10834	47k 1% 0,1W
3104	4822 051 20154	150k 5% 0,1W
3105	4822 051 20392	3k9 5% 0,1W
3106	4822 117 10833	10k 1% 0,1W
3107	4822 051 20104	100k 5% 0,1W
3108 ⚠	4822 052 10478	4Ω7 5% 0,33W

COILS

5100 ⚠	4822 214 51841	MAINS FILTER

DIODES

6100	5322 130 30684	1N4002RL
6101	4822 130 34488	BZX79-B11
6102	4822 130 82714	BZX79-B2V7
6103	5322 130 30684	1N4002RL
6104	5322 130 30684	1N4002RL
6105	5322 130 30684	1N4002RL
6106	5322 130 30684	1N4002RL
6107	4822 130 30621	1N4148
6108	4822 130 30621	1N4148
6109	4822 130 30621	1N4148
6110	4822 130 31981	BZX79-B3V9
6111	5322 130 30684	1N4002RL
6112	5322 130 30684	1N4002RL
6113	5322 130 30684	1N4002RL
6114	5322 130 30684	1N4002RL
6115	5322 130 30684	1N4002RL
6116	5322 130 30684	1N4002RL
6117	5322 130 30684	1N4002RL
6118	5322 130 30684	1N4002RL

IC's

7100	4822 209 12715	IC L7915CV
7101	4822 209 13061	L4940V5
7102	4822 130 61207	BC848
7103	4822 130 61207	BC848
7104	4822 130 61207	BC848
7105	5322 130 42012	BC858A
7106	4822 209 15867	L4940V12
7107	4822 209 73492	L7912CV
7108	4822 209 82112	MC7908CT

DISPLAY , HEADPHONE & LEVEL BOARD

MISCELLANEOUS

1003	4822 256 10401	FTD-HOLDER
1201	4822 276 13114	TACT SWITCH
1202	4822 276 13114	TACT SWITCH
1203	4822 276 13114	TACT SWITCH
1204	4822 276 13114	TACT SWITCH
1205	4822 276 13114	TACT SWITCH
1206	4822 276 13114	TACT SWITCH
1207	4822 276 13114	TACT SWITCH
1208	4822 276 13114	TACT SWITCH
1209	4822 276 13114	TACT SWITCH
1210	4822 276 13114	TACT SWITCH
1211	4822 276 13114	TACT SWITCH
1212	4822 276 13114	TACT SWITCH
1213	4822 276 13114	TACT SWITCH
1230	4822 242 10753	RESONATOR 8MHZ
1301	4822 267 31453	HEADPHONE SOCKET

CAPACITORS

2200	5322 122 32654	22nF10%X7R 63V
2201	5322 122 32658	22pF 5% 50V
2202	5322 122 32658	22pF 5% 50V
2203	5322 122 32654	22nF10%X7R 63V
2204	5322 122 32658	22pF 5% 50V
2205	5322 122 32658	22pF 5% 50V
2206	4822 122 33342	33nF10%X7R 63V
2207	5322 122 32654	22nF10%X7R 63V
2300	4822 122 33325	470nF 16V
2301	4822 122 33325	470nF 16V
2302	5322 122 34123	1nF10%X7R 50V
2303	5322 122 34123	1nF10%X7R 50V
2350	4822 124 22339	100µF 16V
2351	4822 124 22339	100µF 16V
2352	5322 122 32654	22nF10%X7R 63V
2353	5322 122 32654	22nF10%X7R 63V
2354	4822 124 11892	100µF 20% 16V
2355	4822 124 11892	100µF 20% 16V

RESISTORS

3200	4822 051 20393	39k 5% 0,1W
3201	4822 051 10102	1k 2% 0,25W
3202	4822 051 10102	1k 2% 0,25W
3205	4822 051 20101	100Ω 5% 0,1W
3206	4822 051 20101	100Ω 5% 0,1W
3207	4822 051 20472	4k7 5% 0,1W
3208	4822 051 20472	4k7 5% 0,1W
3209	4822 051 20472	4k7 5% 0,1W
3210	4822 051 20472	4k7 5% 0,1W
3211	4822 051 20472	4k7 5% 0,1W
3212	4822 051 20472	4k7 5% 0,1W
3213	4822 051 20472	4k7 5% 0,1W
3214	4822 051 20472	4k7 5% 0,1W
3215	4822 051 20008	0Ω JUMP. (0805)
3216	4822 051 20008	0Ω JUMP. (0805)
3300	4822 117 11383	12k 1% 0,1W
3301	4822 117 11383	12k 1% 0,1W
3302	4822 051 20273	27k 5% 0,1W
3303	4822 051 20273	27k 5% 0,1W
3304	4822 051 20121	120Ω 5% 0,1W
3305	4822 051 20121	120Ω 5% 0,1W
3306	4822 051 20122	1k2 5% 0,1W
3307	4822 051 20122	1k2 5% 0,1W
3310	4822 101 21199	10kX2 20% 0,025W
3350	4822 116 83933	15k 1% 0,1W
3351	4822 116 83933	15k 1% 0,1W
3352	4822 117 10358	5k6 1% 0,1W
3353	4822 117 10358	5k6 1% 0,1W
3354 ⚠	4822 117 11747	12Ω 1206 5% FUSE
3355 ⚠	4822 117 11747	12Ω 1206 5% FUSE
3360	4822 101 11821	POTMETER 20k*2
4000	4822 051 10008	0Ω00 5% 0,25W
4001	4822 051 10008	0Ω00 5% 0,25W
4003	4822 051 10008	0Ω00 5% 0,25W
4004	4822 051 10008	0Ω00 5% 0,25W
4005	4822 051 10008	0Ω00 5% 0,25W
4006	4822 051 10008	0Ω00 5% 0,25W
4007	4822 051 10008	0Ω00 5% 0,25W
4008	4822 051 10008	0Ω00 5% 0,25W
4009	4822 051 10008	0Ω00 5% 0,25W
4010	4822 051 10008	0Ω00 5% 0,25W
4011	4822 051 10008	0Ω00 5% 0,25W
4012	4822 051 10008	0Ω00 5% 0,25W
4013	4822 051 10008	0Ω00 5% 0,25W
4014	4822 051 10008	0Ω00 5% 0,25W
4015	4822 051 10008	0Ω00 5% 0,25W
4016	4822 051 10008	0Ω00 5% 0,25W
4017	4822 051 10008	0Ω00 5% 0,25W
4018	4822 051 10008	0Ω00 5% 0,25W
4019	4822 051 10008	0Ω00 5% 0,25W
4020	4822 051 10008	0Ω00 5% 0,25W
4021	4822 051 20008	0Ω00 JUMP. (0805)
4022	4822 051 10008	0Ω00 5% 0,25W
4023	4822 051 20008	0Ω00 JUMP. (0805)
4025	4822 051 10008	0Ω00 5% 0,25W
4300	4822 051 20008	0Ω00 JUMP. (0805)
4301	4822 051 20008	0Ω00 JUMP. (0805)
4310	4822 051 20008	0Ω00 JUMP. (0805)

FILTERS

5300	4822 242 10805	EMI FILTER
5301	4822 157 11402	EMI FILTER

DIODES & IC's

6200	4822 212 30842	TFMS5360
7200	4822 209 15868	TMP87C874F(USER)
7205	4822 135 00149	BJ563GK
7300	4822 209 82362	NJM4556D
7301	5322 130 42136	BC848C
7302	5322 130 42136	BC848C
7350	4822 209 30095	LM833D

CONNECTOR BOARD

MISCELLANEOUS

1500	4822 265 11103	CONNECTOR 16P
1520	4822 212 23837	PLR102 OPTICAL IN
1521	4822 218 21019	PLT102 OPTICAL OUT
1530	4822 267 31823	ANALOG IN/OUT CINCH
1531	4822 267 31448	DIGITAL IN/OUT CINCH

CAPACITORS

2500	5322 122 32659	33pF 5% 50V
2501	4822 124 41579	10µF 20% 50V
2502	4822 122 33342	33nF10%X7R 63V
2503	4822 122 33342	33nF10%X7R 63V
2504	5322 122 32654	22nF10%X7R 63V
2505	5322 122 33538	150pF 2%np0 63V
2506	5322 122 32654	22nF10%X7R 63V
2507	5322 122 32654	22nF10%X7R 63V
2508	5322 122 32654	22nF10%X7R 63V
2509	5322 122 32654	22nF10%X7R 63V
2510	5322 122 32531	100pF 5%np0 50V
2511	5322 122 32531	100pF 5%np0 50V
2512	5322 122 32659	33pF 5% 50V
2513	5322 122 32659	33pF 5% 50V

RESISTORS

3500	4822 051 20822	8k20 5% 0,1W
3501	4822 117 11152	4Ω7 5%
3502	4822 051 20101	100Ω00 5% 0,1W
3503	4822 051 20689	68Ω00 5% 0,1W
3504	4822 117 11152	4Ω7 5%
3505	4822 051 20332	3k30 5% 0,1W
3506	4822 051 20332	3k30 5% 0,1W
3507	4822 117 11152	4Ω7 5%
3508	4822 051 20759	75Ω00 5% 0,1W
3509	4822 051 20104	100k00 5% 0,1W
3510	4822 051 20104	100k00 5% 0,1W
3511	4822 117 11373	100Ω 1% RC12H 0805
3512	4822 117 11449	2k2 1% 0,1W
3513	4822 117 11373	100Ω 1% RC12H 0805
3514	4822 117 11449	2k2 1% 0,1W
3515	4822 117 11373	100Ω 1% RC12H 0805
3516	4822 117 11449	2k2 1% 0,1W
3517	4822 117 11373	100Ω 1% RC12H 0805
3518	4822 117 11449	2k2 1% 0,1W
4500	4822 051 20008	0Ω00 JUMP. (0805)

COILS

5450	4822 157 70601	DIGITAL OUT TRAFO

IC'S

7500	5322 209 11517	PC74HCU04T
7501	4822 130 60511	BC847B
7502	4822 130 60511	BC847B
7503	4822 130 60511	BC847B
7504	4822 130 60511	BC847B

MAINS VOLTAGE

1006 ⚠	4822 146 10871	TRANSFORMER /00/13
1006 ⚠	4822 146 10872	TRANSFORMER /11
1006 ⚠	4822 146 10873	TRANSFORMER /17

CONNECTIONS

8005	4822 320 12147	CWAS FLEX 16P

Service
Service
Service

The basics of Compact Disc Recordable and Compact Disc ReWritable (reference set is CDR870)

Circuit Description

Table of Contents

1. Introduction
2. CD-Recording discs
3. The CD-Recordable/ReWritable Audio Recorder

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GB 4822 725 25242

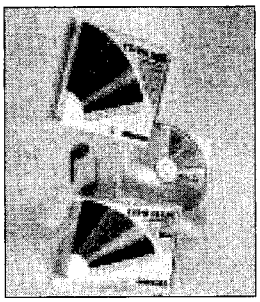
PHILIPS

Making your own CDs - the final functionality for your audio system

This unique Philips CD-Recorder gives you the capability, for the first time, to make your own top-quality audio CDs, on either 'write-once' CD-Recordable discs or re-usable CD-ReWritable discs. Subject to the digital copy constraints of the SCMS system, you can make CDs from all analogue or digital sources in your audio system.

Discs can be recorded all at once, or in stages, known as 'sessions'.

Just as on a prerecorded CD, you can put track numbers on your own discs, automatically or manually, depending on the source and your own preference. And when 'finalized' for playback, these discs behave in exactly the same way as your regular prerecorded CDs.



CD-Recordable - The 'Write-Once' Discs

Blank CD-Recordable (CD-R) discs feature an organic dye layer for recording, applied over a substrate containing a wobbulated 'pre-groove' to guide the laser beam. The 'pre-groove' is FM modulated with time code and other disc information. The average wobbulation frequency is used to control the turntable speed, while the time code is used to position the recordings on the disc. During recording, the laser forms 'bumps' in the dye layer, which have the same effect as the pits in a pre-recorded CD. When fully recorded and 'finalized', CD-R discs are fixed for life, and will play on all CD players and recorders.

CD-Rewritable - The Erasable And Reusable Disc

Blank CD-ReWritable (CD-RW) discs use 'phase change' technology for recording, and the same wobbulated 'pre-groove' principle. A low-reflectance domain of amorphous (or non-crystalline) phase, is produced when the laser heats the recording layer rapidly above its melting point of 500-700° C. Cooling quickly, this amorphous domain 'freezes' and becomes reflective. If, on the other hand, the recording layer is heated to a rather lower temperature for a somewhat longer time, a light-diffusing crystalline phase is formed. Because these changes are reversible, CD-RW discs can be erased and rewritten, at least a thousand times.

During recording, individual tracks can be erased; when fully recorded and 'finalized', these discs must be erased completely before re-use. Finalized CD-RW discs will play on all CD-RW-compatible CD players and recorders. Philips will start to make it's CD-players compatible with RW-discs in 1998.

Note: The CDR-870 is designed to use CD-R and CD-RW discs optimized for audio recording, and bearing these logos.CD-R and CD-RW discs produced specially for use with CD-R/RW computer drives are not suitable. The logo's on these discs do not contain 'Digital Audio'.

Analogue Recording

This is just like recording on to cassette tape. You adjust the record level control so that the loudest passages fill the blue section of the record level meter on the display, without going into the red overload section.

If you choose automatic track numbering, the CDR 870 inserts a new track number each time it detects a 3-second pause in the music. With manual track numbering, you can insert track numbers any place you like during recording. When the recording stops, the discs's temporary Table Of Contents is automatically updated, and when you come back to resume recording, the player automatically finds the end of the last recording session.

Digital Recording

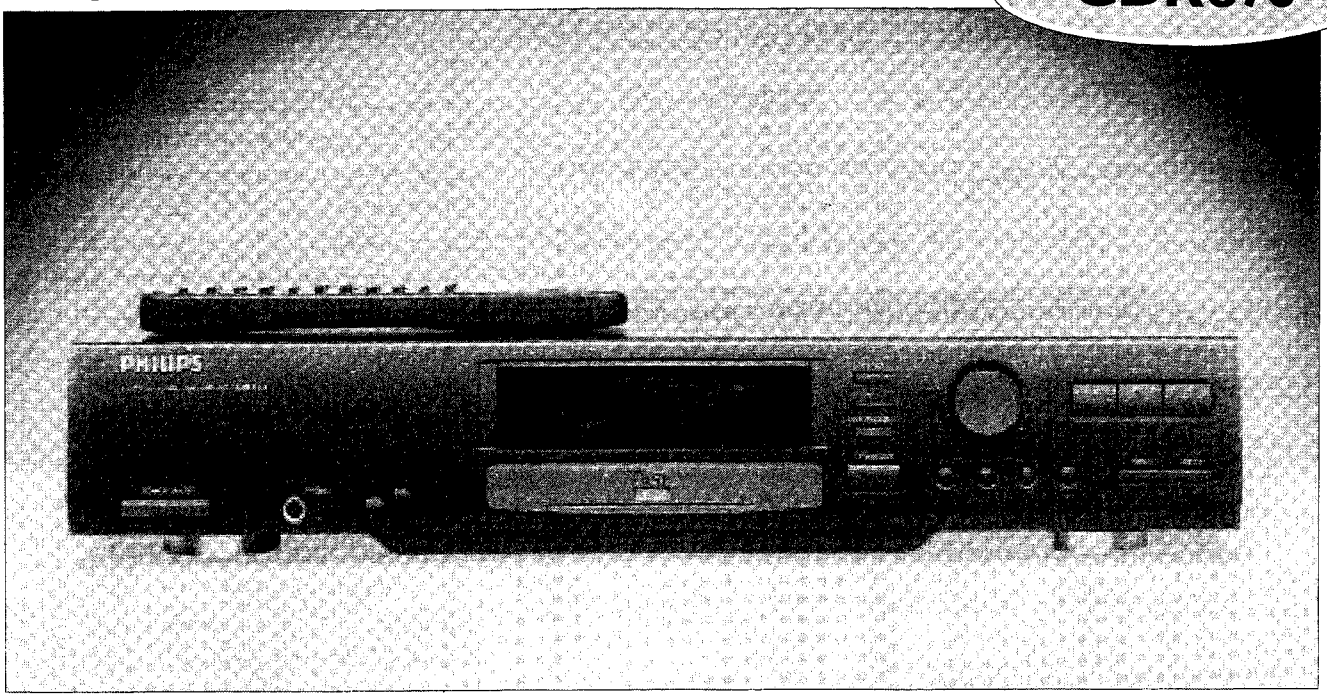
No record level setting is required for digital recording; the level is regulated in the digital input signal.

If you choose automatic track numbering, the CDR 870 inserts track numbers directly from the source material.

With manual track numbering, you can

Philips Sound & Vision

CDR870



Philips CD-Recorder

The fulfilment of a long-standing wish: with this Philips CD-Recorder, you can make your own audio CDs, on your home audio installation. Compilations made from your favourite music will play back, in the original sound quality, not only on the CDR 870 itself, but also on your car CD player, sound machine, portable CD player, or any other CD playback device.

The CDR 870 gives you the choice of creating your own CDs on 'write-once' CD-Recordable discs or on re-usable CD-ReWritable discs, all at once or in sessions.

- **Records and plays CD-Recordable and CD-ReWritable discs; plays all audio CDs**
- **Records from all home stereo analogue and digital sources**
- **Optical and coaxial digital input and output**
- **Automatic sample rate conversion from 32 and 48 kHz to 44.1 kHz**
- **Automatic or manual track numbering**
- **CD-Sync autostart recording from digital sources**
- **SCMS Serial Copy Management System**
- **Precision diecast mechanism**
- **1-bit Analogue-to-Digital converter**

COMPACT disc DIGITAL AUDIO Recordable ReWritable

COMPACT disc DIGITAL AUDIO

again insert track numbers any place you like during recording.

When the recording stops, the discs's temporary Table Of Contents is automatically updated, and when you come back to resume recording, the player automatically finds the end of the last recording session.

CD Sync Recording

With this ultimate convenience feature, recording starts automatically as soon as the source begins to play.
CD-Sync Recording lets you record either individual tracks or an entire disc from any digital input, with automatic or manual track numbering.

SCMS

The CDR 870 incorporates the internationally-accepted SCMS Serial Copy Management System. With SCMS, only single direct copies of digital source material are permitted: it is not possible to copy digital copies.

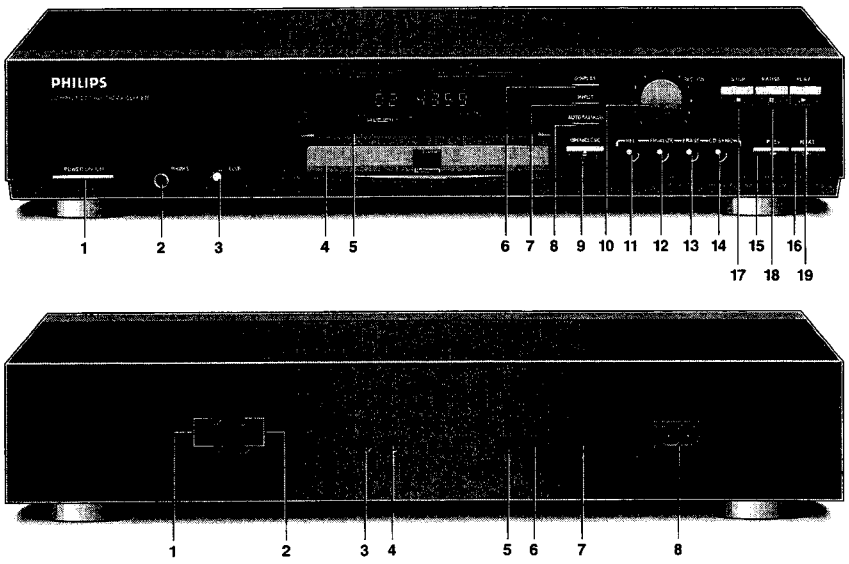
Finalizing A Disc

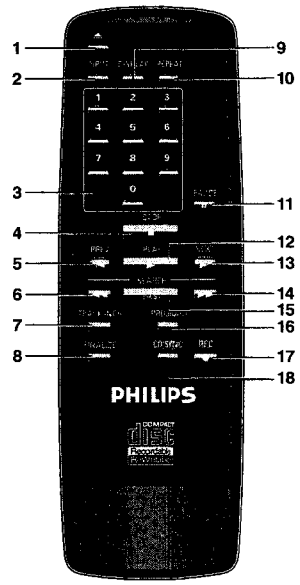
Finalizing a fully-recorded disc is a simple matter of pressing the Finalize key, followed by Record. Once initiated, the procedure is fully automatic.

After finalization, discs will play on other CD players or recorders, but further music tracks cannot be added.
CD-RW discs can be rewritten after they have been completely erased.

Playback

The CDR 870 has all the familiar CD playback features: play, pause, next and previous track, track selection by number, 2-speed fast forward and reverse search, and programmed playback.





Front

1 POWER ON/OFF
2 Headphone jack (PHONES)
3 Headphone level (LEVEL)
4 Disc tray
5 Display
6 OPEN/CLOSE
7 Record (REC)
8 FINALIZE
9 ERASE
10 CDSYNC
11 Previous track selection (PREV)
12 Next track selection (NEXT)
13 PLAY
14 PAUSE
15 STOP
16 Level Meter (analogue input)
17 AUTO/MANUAL track increment selection
18 DISPLAY indication selection
19 INPUT select

Rear

1 Analogue line input jacks
2 Analogue line output jacks
3 Digital input
4 Digital output
5 Optical digital input
6 Optical digital output
7 Voltage selector (not on all versions)
8 AC Mains input

Remote

1 OPEN/CLOSE
2 INPUT selector
3 Numeric buttons 0-9
4 STOP
5 PREVIOUS
6 Search reverse button
7 TRACK INCRement
8 FINALIZE
9 CDSYNC
10 REC
11 PROGRAM
12 FAST search button
13 Search forward button
14 NEXT
15 PLAY
16 PAUSE
17 REPEAT
18 DISPLAY indication modes

The products and services described here are not necessarily available in all countries. Due to continuous product improvements this specification is subject to change without notice. Printed in the Netherlands. 08/97 3122 321 78132

TECHNICAL SPECIFICATIONS CDR870

GENERAL

System	Compact disc digital audio
Number of channels	2 (stereo)
Applicable discs	CD, CD-R, CD-RW
Power supply	AC 230V (/00), 120V (/17), 120/230V (/11)
Power consumption	15W
Operating temperature	5-35°C
Weight	4 Kg
Dimensions	435 x 310 x 75 mm (w x d x h)

AUDIO

Frequency response	20 Hz - 20 kHz
Playback S/N	105 dB
Playback dynamic range	98 dB
Playback total harmonic distortion	85 dB
Recording S/N	90 dB
Recording dynamic range	95 dB
Recording total harmonic distortion	85 dB
Line output voltage	2 Vrms
Digital coaxial output	0.5V(pp)/75Ω
Digital optical output	-20 dBm
Headphones	0-5Vrms/8-2000Ω
Recording values for line input/output	
Digital coaxial input (automatic sample rate conversion)	32-48 kHz
Digital optical input (automatic sample rate conversion)	32-48 kHz
Analogue input	700mVrms/50 kΩ

RECORDING FUNCTIONS

- Recording
- Auto start recording (Cdsync)
- Pause recording
- Erase last track (CD-RW disc)
- Erase disc (CD-RW disc)
- Manual track Increment
- Automatic track Increment
- Remaining recording time display
- Finalize (writing TOC)
- SCMS (Serial Copy Management System)
- RID code (Recorder Unique Identifier)

PLAYBACK FUNCTIONS

- Play
- Pause
- Stop
- Direct track selection
- Next/Previous track selection
- Search forward/reverse
- Fast search forward/reverse
- Repeat (all/1-track)
- Program play (20 tracks)
- Time display switching

ACCESSORIES

- Remote control (+batteries)
- Audio cable (x2)
- Digital coaxial cable (x1)
- AC mains cable

IMPORTANT:

IT IS A CRIMINAL OFFENCE, UNDER APPLICABLE COPYRIGHT LAWS, TO MAKE UNAUTHORISED COPIES OF COPYRIGHT-PROTECTED MATERIAL, INCLUDING SOUND RECORDINGS. THIS EQUIPMENT SHOULD NOT BE USED FOR SUCH PURPOSES.

Philips Sound & Vision
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1 Introduction

1.1 The CD-Recording system

The CD-Recording system consists of a CD-Recorder/player and the exchangeable software carrier CD-Recording disc. Most known CD systems, like CD-Audio, CD-ROM, CD-I CD-ROM XA, Photo CD, Video CD are pre-recorded systems, and lack the facility of recording as enjoyed by tape systems. This CD-Recording system addresses this deficiency. Dependant to the applied disc carrier two different solutions are in use: CD-Recordable and CD-ReWritable.
CD-Recordable (CD-R), a so-called Write-Once principle, has the advantage of full compatibility with all pre-recorded CD systems.
CD-ReWritable is able to write, read and rewrite CD-ReWritable discs (CD-RW). CD-RW discs have a lower reflectance than standard CDs and therefore cannot be played-back by all today's CD players.
Above that both recording disc systems can be split to a Professional application (e.g. CD-ROM) and a Consumer (Audio) application.
Both applications have their own CD-Recordable and CD-ReWritable discs with appropriate logo, to comply with copyright legislation in various countries. The Audio CD-Recorder/player will only make recordings on CD-R and CD-RW discs bearing the appropriate 'Digital Audio' logo. These discs are subject to levies that are payable to the relevant copyright protection associations.
Concerning the lower reflectance of Audio CD-RW discs:
For CD-Audio players, from production 1998 onwards, Philips intends to extend all her future CD-Audio players so that they will be able to play Audio CD-ReWritable discs.
With the introduction of the CD-R/RW Audio Recorder at the end of 1997 both recording functions (Recordable and ReWritable) are combined in one Audio CD-Recorder/player.
This description assumes the knowledge of the conventional CD-Audio system.

1.2 The most important differences between CD-R/CD-RW discs and pre-recorded CDs.

The main physical difference between CD-R/CD-RW disc types and the pre-recorded CD is that the latter has no recording layer; the information is permanently stamped in the aluminium reflecting layer.
There is also a difference in terms of the data areas on the disc. Compared with standard CDs, there is a CD-R/CD-RW area that is located in front of the Lead-In Area. This additional area is used to store data specific to the recording process and is divided into the Program Memory Area (PMA) and the Program Calibration Area (PCA). In chapter 2.5 Data Organization these areas are explained in more detail.
As long as recordings are made on the disc the Lead-In Area is not filled. At the moment the recording disc is converted into a standard CD-format, the PMA information is recorded in the Lead-In Area. This process is called 'Finalizing', because after this procedure no more recordings on this disc can be made.

1.3 The requirements for the CD-Recording system

The most important requirement for the CD-Recording system is to be compatible with the conventional CD-Audio system. The CD-Recording system has an added advantage to make an incremental recording. This means that a recording session can be interrupted at any time, and can be continued at a later time, possibly using a different recorder. The successive parts of information are recorded sequentially on the disc.

The Audio recorded disc is compatible with the CD-Audio system.
This is only true for the fully recorded CD-R disc, which means that the Lead-In Area has been recorded after the recording of the last track of the disc (Finalizing). For 'finalized' CD-RW discs (reflection) adapted players will play back these discs only.

The blank CD-Recording disc contains a sensitive layer of a material which has a reflection decrease if an effect (called a pit) is recorded by heating up the sensitive layer locally. The requirements for the recorded signals as well as for the rest of the disc parameters are basically the same as the CD-Audio system.
In other words, the CD-Recording system is fully compatible with the conventional CD-Audio system.

The Audio CD-Recorder/player is a CD-Audio player with the following basic functions:
- It can play back a disc of the existing CD-disc standard, so it is a player which is compatible with the Compact Disc system.
- It makes recording on the recording disc according to CD-Recordable or CD-ReWritable standard possible.
- It enables to play back a partially recorded disc.
- It records additional tracks on partially recorded disc.
- It makes a fixing up of a recorded disc to a compatible disc of the existing CD-disc standard (Finalizing).

Other main parameters are:
- Recording/playing time is equal to normal CD (max. about 74 minutes).
- Scanning velocity of the laser spot: Constant Linear Velocity (CLV) is 1.2 to 1.4 m/s.
- Disc diameter is 120 mm.
- CIRC/EFM encoding.
- Track pitch is nominally 1.6 µm. The Program Area is recorded between 50 and max. 116 mm diameter.
- Audio encoding: 2 channel stereo, 16 bit quantization, 44.1 kHz sampling frequency.
- Data encoding: block encoding with approximate user data transfer rate of 1.4 Mbit/s.

All these parameters are a contribution to guarantee the exchangeability between all Compact Discs and CD-Recording discs recorded on other CD-Recording players.

The CD-Recording disc has to meet with the mechanical and optical specifications lay down in the CD-Recordable and CD-ReWritable standard.

2 CD-Recording discs

2.1 The CD-Recording discs

Both CD-R and CD-RW discs have the same basic structure but with significant differences. The CD-R disc has a dye-based recording layer, with a reflectivity of 40 - 70%, while the CD-RW disc has a phase-change recording layer with a reflectivity of 15 - 25%. Both discs have an additional reflecting layer: golden for the CD-R, which accounts for that disc's distinctive appearance, and silver (aluminium) for the CD-RW.

2.1.1 Dimensions

In figure 1, 2 and 3 the dimensions of the unrecorded, partially recorded and recorded disc are drawn.

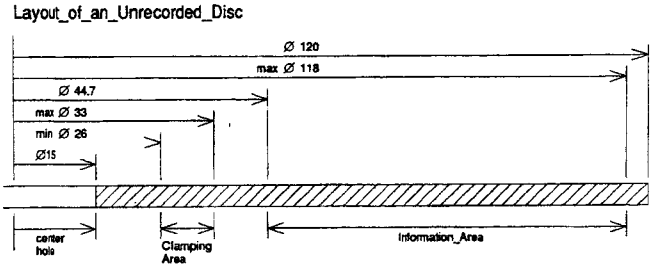

Figure 1
Layout of the unrecorded disc

The most important difference between the conventional disc and the recordable disc is the beginning of the Information Area. Between diameter 44.7 and 46 mm there is the information of temporary table of contents of the disc: PCA en PMA. See figure 2. The meaning of the PCA and PMA are explained in chapter 2.5: "Data organization".

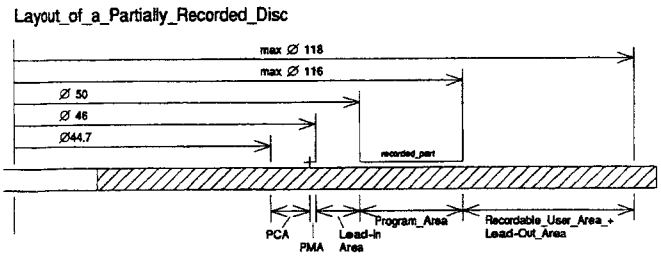

Figure 2
Layout of the partially recorded disc

The line above the disc surface indicates the recorded part.

After the fixing up of the disc the temporary table of contents is moved to the Lead-in Area of the disc. See figure 3.

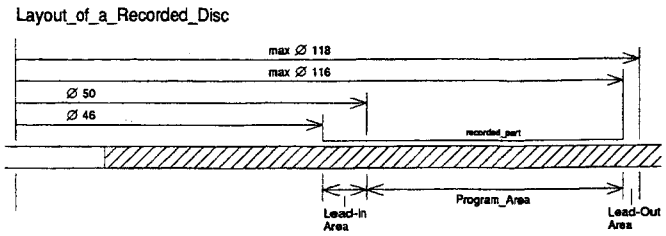

Figure 3
Layout of the recorded disc

The line above the disc surface indicates the recorded part.

2.1.2 The structure

The PC-substrate of the CD-Recording disc is basically the same as for a conventional pre-recorded CD.
In a pre-recorded CD, the reflection layer contains a spiral shaped track consisting of depressions, the so called: "pits". The aluminium reflection layer on top of this substrate contains the same pit pattern.
In the CD-Recording disc, the reflection layer contains a spiral shaped groove instead of pits. Later on the pits will be recorded 'under' this groove. On a blank disc, the groove is important because it enables rotational speed control, radial tracking control and time indication on the disc (see chapter 2.5, "Data organization").
Between the substrate and the grooved surface of the reflective layer (gold or aluminium) is the sensitive layer (an organic dye material). Additionally a protective coat and a label are used. A cross-section of a CD-R disc is drawn in figure 4. The substrate layer is of polycarbonate material: PC-substrate; the golden reflective layer is called AU-reflective layer;

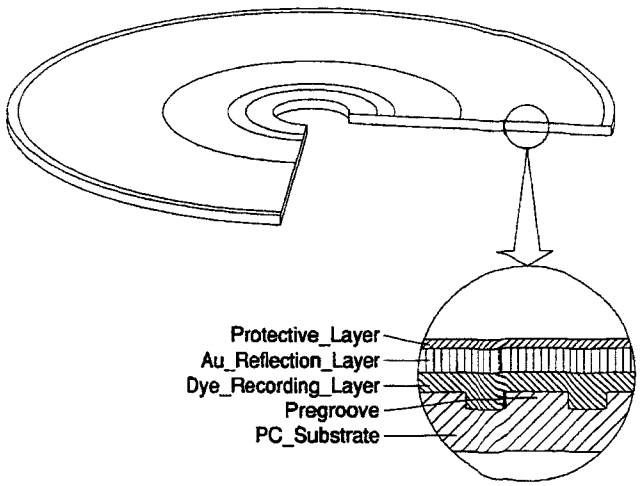

Figure 4
A cross section of the CD-R disc

2.2 The principle of recording

2.2.1 The writing process CD-R

In figure 4 is shown the cross-section of the recordable disc, which consists of protective layer, AU reflection layer, Dye recording layer and PC-substrate.
The proper working of the pre-recorded CD-Audio system has been realised by the difference of the intensity of the reflected light between pits and lands. Due to the diffraction caused by the pits the light-intensity of the reflection deviates.
If an unrecorded CD-R disc has been read the intensity of the laser beam is so low that nothing changes on the disc and almost all laser light will be reflected. With the reflected information the position of the laser-spot with respect to the pregroove will be detected and the pregroove track will be followed.
In the recording mode the intensity of the laserlight is at the same intensity to read and follow the pregroove information. On that location where a pit should be written the intensity of the laserlight will be increased to a high level. Now all laserbeams will be reflected by the AU-reflection layer. The energy of the laserlight (in the range 4 - 11mW) causes limited heating of the Dye recording layer and the PC-substrate to approximately 250°C. At this temperature the recording layer melts reducing its volume, while the substrate expands into the space that becomes available. By constant switching between writing and reading power, a pit pattern corresponding to that of a pre-recorded CD is produced.

The write pulse initially has a higher power to produce the required heating of the dye. Subsequently, the power is reduced to a level that is sufficient to maintain the dye temperature at the desired level. (See also detailed information at paragraph 3.2.2.2. Optical Power Calibration)

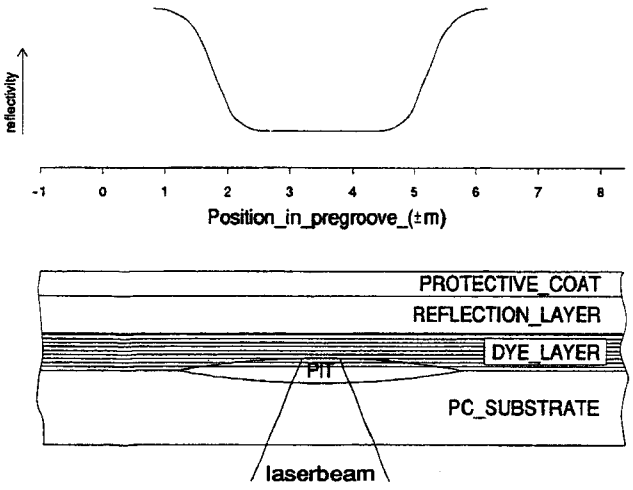

Figure 5
The principle of recording on CD-R disc

The write pulse initially has a higher power to produce the required heating of the dye. Subsequently, the power is reduced to a level that is sufficient to maintain the dye temperature at the desired level. (See also detailed information at paragraph 3.2.2.2. Optical Power Calibration) See figure 6.

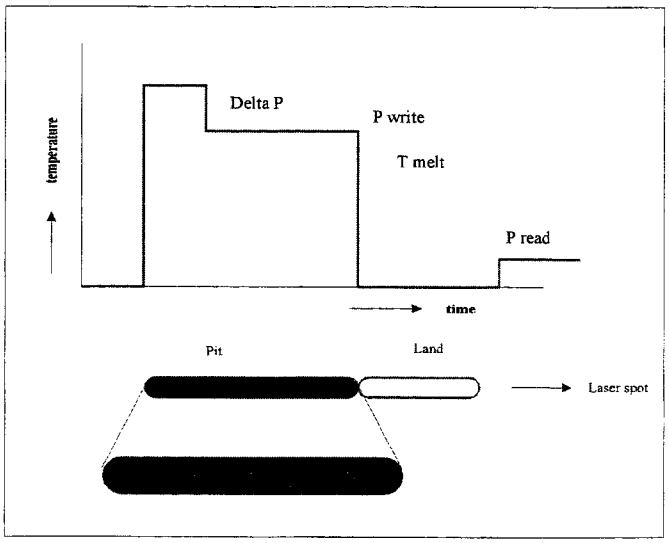

Figure 6
The CD-Recordable write pulse

2.2.2 The Writing process CD-RW

2.2.2.1 Recording

In the CD-RW disc the recording layer is made of an alloy of silver, indium, antimony and tellurium. In its original state, this layer has a polycrystalline structure. During the recording process, the laser selectively heats tiny areas of the recording track to a temperature above the layer's melting point (500 - 700°C). For CD-RW writing, the laser power used is in the range 8 to 14mW.
The pulsed energy delivered by the laser beam melts the crystals in the heated areas into a non-crystalline amorphous phase ('pits'), which has a much lower reflectance than the remaining crystalline areas ('lands'). This difference in reflectance allows the recorded data to be read-out, producing a signal similar to that obtained from a standard CD. The physical characteristics of the amorphous phase are 'frozen-in' during cooling, making the recording just as permanent as any standard CD. See figure 7.

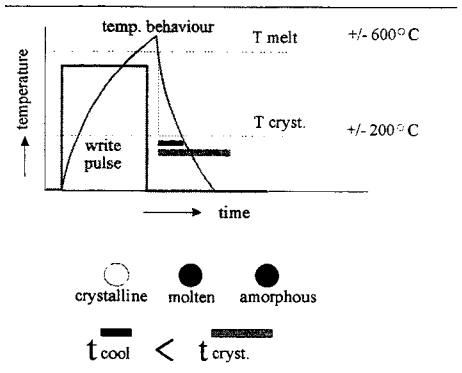

Figure 7
CD-RW writing

2.2.2.2 Erasing

Erasing of a CD-RW disc is performed by returning the material in the recording layer which has been changed to the amorphous state back to the crystalline state. This is done by an annealing process, consisting of heating the layer to a temperature of about 200°C (= less than melting point) and maintaining that temperature for an extended period. The disc is than returned to its original, completely unrecorded state. This function is called **DC-Erase** and takes about 37 minutes for a complete disc. See figure 8.
A much faster 'on the fly' erasing facility is also available, allowing the last recorded track to be erased simply by erasing the subcode reference to that track while leaving the recorded data in place in the recording layer.

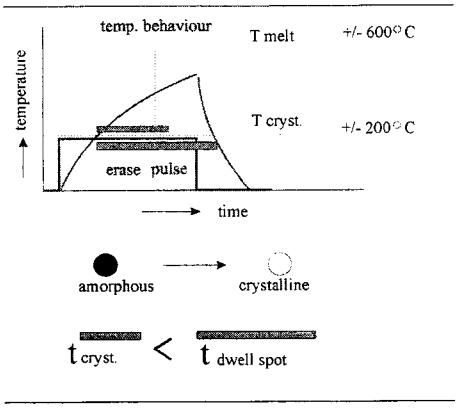

Figure 8
CD-RW erasing

2.2.2.3 Overwriting

A direct overwrite strategy is obtained by combining the write and erase technologies. In this case, new pits are written in the recorder layer using the same pulsed laser beam energy as in the recording strategy. However, in the areas between the newly recorded pits, a lower-energy, non-pulsed laserbeam is switched to the lower-energy erase level between the new pits, resulting in complete erasure of the audio data that was formerly contained on these areas.
As in the writing of a CD-R disc, a higher energy level is used initially to create the temperature increase required to melt the recording layer. Between the pits, the temperature is reduced to the erase level. This provides a higher starting temperature, so less energy is subsequently needed each time the melting temperature has to be reached. See figure 9.

2.3 The groove in the CD-Recording discs

2.3.1 Dimensions

In a conventional CD system the spiral shaped track with pits is used for radial tracking, rotational speed control and time indication. As there are no pits in the blank CD-R disc, the groove in the substrate is used for the same purposes.
The typical dimensions of such a groove are:
- width : 600 nm
- depth : 100 nm
- profile : U-shape

A groove with these dimensions can be used for radial tracking of the laser spot.

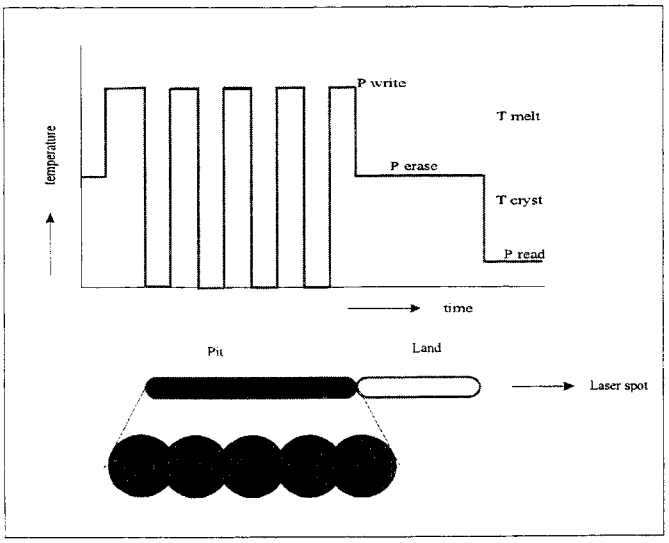

Figure 9
CD-RW overwriting

2.3.2 The wobble of the groove

The groove is not a perfect spiral. It deviates from the ideal spiral shape with a sine wave. The amplitude of this sinusoidal radial deviation is typically 30 nm, and the spatial period is about 60 µm. This wobbling of the groove is visible in the reflected read out light beam (more specific: in the radial tracking error signal derived from it). By locking the wobbling read out signal to a specified frequency of 22.05 kHz, the disc will rotate at the correct rotational velocity.

2.3.3 The wobble modulation

The groove is not wobbled with a constant period of the sinewave. Around the average frequency of 22.05 kHz it is additionally modulated in frequency with a deviation of ± 1 kHz. By adding this modulation to the groove wobble, additional information is stored in the disc. The most important information is the absolute time, which increases monotone from inside to outside the diameter of the disc. This is called ATIP: Absolute Time In Pregroove.

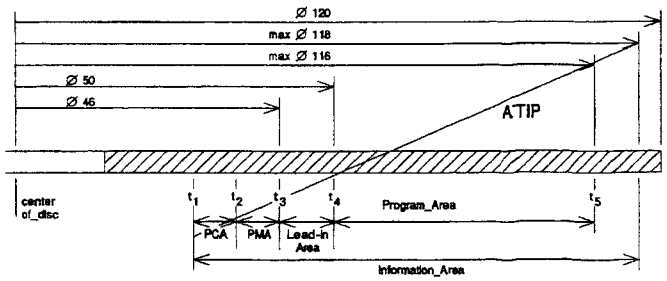

Figure 10
ATIP versus disc diameters

Apart from this time, ATIP contains:
- An approximate value of the laser recording power for the disc.
- The last possible start time of the Lead Out Area (see paragraph 2.5.5).
- The Disc Application Code, which distinguishes between discs used for different applications:
  1: 'Discs for restricted use' (professional use).
  2: 'Discs for unrestricted use' (consumer use).

2.4 The requirements for the CD-Recording discs

2.4.1 The unrecorded (blank) disc

Most disc and signal parameters of the unrecorded CD-Recording discs are identical to the corresponding parameters for conventional CD. The main additional requirements, related to the recording capability of the disc, are in the write condition the optimum recording power and the wavelength of the recording spot. The reflection in the unwritten part should be approx. 70%.

2.4.2 The recorded disc

The recorded disc fulfils all requirements of conventional CD system.
The main additional requirements, related to the recording capability of the disc are in the read condition the normal reading power and the wavelength of the recording spot. The reflection of the land should be approx. 70% and the written part (pit) should be approx. 30%. It is about this reflection the CD-ReWritable disc is deviating from the original standard. Updating of standard has been realized, CD players have to be adapted accordingly.

2.5 Data Organization

The CD-R disc is divided into five different area's. This chapter describes what the purpose of each area is, which data should be recorded in it, and in what sequence the data should be recorded. The five different area's, from inside to outside diameter are (see figures 1 to 3 and 10):
- Power Calibration Area (PCA).
- Program Memory Area (PMA).
- Lead In Area.
- Program Area.
- Recordable User Area + Lead Out Area.

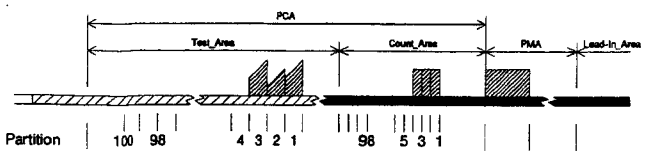

Figure 11
Organization of the PCA, PMA and Lead In Area

On this disc there is an incrementally, partially recorded CD-R disc. The hatched area's are recorded parts of the disc.

Since Incremental Recording (or interrupted recording, see chapter 1.3 "The requirements for the CD-Recording system") is possible, there are requirements for the linking of the different successive recordings.

Also there are requirements for the synchronization between the ATIP time in the groove, and the time encoded in the recorded data.
To prevent misrecordings some hints are given at the end of this chapter.

2.5.1 Power Calibration Area

The PCA is reserved for obtaining the exact optimum recording power for the disc. Using the exact laser recording power improves system margins. At the start up of a recording session, the recorder checks in its memory whether it has already determined the exact power for this particular disc. If not, the procedure for determining the exact power is started.
The PCA is divided into two area's (see figure 11):
1: The Test Area, in which test recordings with different laser powers can be done.
2: The Count Area, which is meant for fast and reliable read out of the part of the Test Area that should be used next.

In total 99 testrecordings can be carried out per disc.

2.5.2 Program Memory Area

In case of Incremental Recording, it is necessary to have an area in which the track data (e.g. start addresses) of the already recorded tracks can be noted temporarily.
When a new recording session starts on a partially recorded disc, all necessary data can be read from this PMA (see figure 11).
The PMA may contain three types of data:
1: Track numbers with their start and stop times. This is the temporary table of contents for the partially recorded disc.
2: Disc Identification. A six digit number can be noted in the PMA to identify each individual disc. This identification number can be used e.g. to avoid repeated fixing of the optimum recording power (see paragraph 2.5.1 "Power Calibration Area").

2.5.3 Lead In Area

The description of this area is basically the same as the one used in conventional CD. It contains the Table of Contents of the finalized recorded disc. Additionally, some extra information like the identification of the disc might be encoded.

2.5.4 Program Area

This is the area where the Audio tracks have been recorded (see figure 2 and 3). The specification of this area is basically the same as the one used in conventional CD. Only the Copy bit is used to indicate a first or higher generation copy of a Copyright protected track.

2.5.5 Recordable User Area + Lead Out Area

The Recordable User Area is the remaining unrecorded (blank) area of the disc where additional tracks can be recorded (see figure 2). The Lead Out Area marks the end of the Program Area. The specification is basically the same as in conventional CD's.

2.5.6 The general linking rules

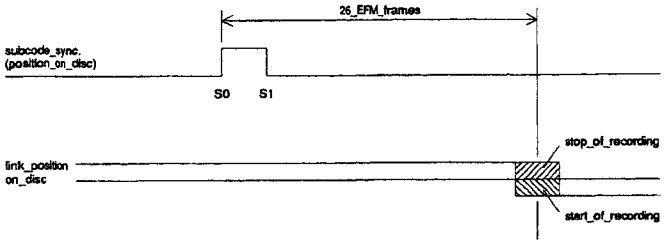

Figure 12
General linking rules

If a piece of music has been recorded the information will be written over the pregroove information. To stop the recording the stop key has to be activated. The writing however continues writing till 26 (EFM-)frames after next subcode sync. It is first after that the CD-R drive stops. If later on the recording on the same disc will be continued, the temporary table of contents in the PMA of the disc carries the information of the last recording and drives the spot (Light Device Unit) to the end of that recorded track. To link to that position the recorder looks for the last recorded subcode sync frame-number. When the recording is activated, the recorder starts reading the first of the extra recorded 26 EFM-frames to assure the timing of the registered signal with the timing of the new recording signal. After those 26 EFM-frames the writing starts really. In this way the EFM signal is adapted to the conventional standard.

2.5.7 Misrecording

Misrecording may occur if during a recording there is a heavy bump against the recorder. Then the spot may be lost from the pregroove. During the recording only at every 13.3 ms the recorder reads the pregroove information. If the times of ATIP do not continue consecutively, caused by the bump, the recording will be stopped. The laser will be switched off but the CD-recordable disc is irreparable damaged. To anticipate to this phenomenon it is necessary to prevent bumps during recording.
See also shock sensitivity, paragraph 3.2.1.4.

Bumps that stop the recording on the CD-ReWritable disc are not destroying this disc. However the recording of the piece of music has failed. With the erasing facility the failed track can be erased and in case the original piece of music is still available a new recording can be re-started.
After a number of recordings it is also possible to erase that complete disc for re-use.
A CD-ReWritable disc can be played back on CD-players prepared for ReWritable Discs after finalizing
(current CD-players are not prepared).

3 The CD-Recordable/ReWritable Audio Recorder

3.1 Blockdiagram of a CD-Recordable/ReWritable Audio recorder

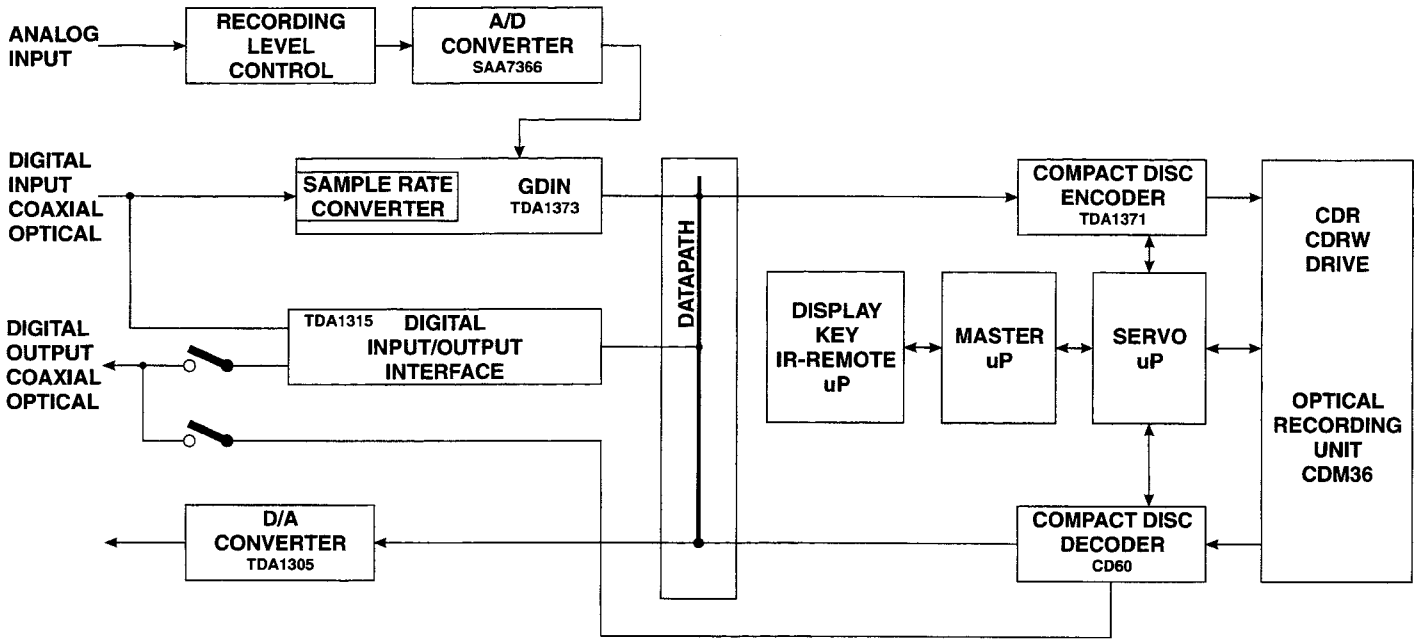

Figure 13
Blockdiagram of a CD-Recordable/ReWritable audio recorder

The Recording signal in above drawn simplified blockdiagram is moving according to the following steps.
Starting at the analogue input side:
- the Analogue input signal to
- the RECORDING LEVEL CONTROL unit and then via
- the Analogue/DIGITAL CONVERTER the analogue signal will be transformed into a digital signal (sample frequency 44.1 kHz) and this digital signal is forwarded via
- the General Digital Input (GDIN) to
- the Datapath bus (I^2S).

The digital input connects the electrical and optical signals directly to the:
- the General Digital Input (GDIN) where via the internal Sample Rate Converter the digital signal is adapted to the CD sample frequency (44.1 kHz) and after that forwarded to
- the Datapath bus.

Via the Datapath bus the digital signal is connected to
- the Compact Disc Encoder, which transforms the signal into EFM format. The EFM signal is forwarded to
- CDR / CDRW Drive unit with optical recording unit (CDM = CDMechanism). In recording mode, but also in play mode this drive is controlled by
- control µProcessor (Servo microcontroller) which on its turn is actuated by
- the Master µProcessor (System controller). This processor co-ordinates all activities which are started by the user via
- the Front Keys and/or IR Remote control signals and the results are displayed on Display unit. These activities are processed by a slave µProcessor (user microprocessor) on the display board and the slave µProcessor communicates with the Master µP.

In Play mode the signal flows as follows:
- From CDR drive the EFM signal read from disc is forwarded to
- Compact Disc Decoder and decoded digital signal is forwarded via
- the Datapath bus (I^2S) to
- Digital/Analogue Converter (Analogue output) or via DOBM IEC958 format to
- Digital and Optical out connector.

Monitoring the audio recorded signal is only possible via the electrical input circuits until Datapath bus and than the output circuit.
Notice that the recorded signal on the disc is not "monitored".
From each input signal there is immediately a digital output signal available at digital out.
The blocks of blockdiagram of figure 14 are gathered in the Basic Engine part with the CDM, servo drivers, Basic Engine µProcessor (or Servo µProcessor), encoder, decoder and the loader unit and the User part is consisting of input and output datapath and User µProcessor (System controller) unit.
The Display part contains the keys & display with slave µP.
The I/O part contains the connectors on the connector board and the Power supply supplies.

For servicing reasons the CDM Loader Module consisting of loader, CDM, CDM board and Main board is treated as one central repair module. Local repairs on component level can be executed on Power supply, I/O connector and Display boards. See next drawing fig. 14.

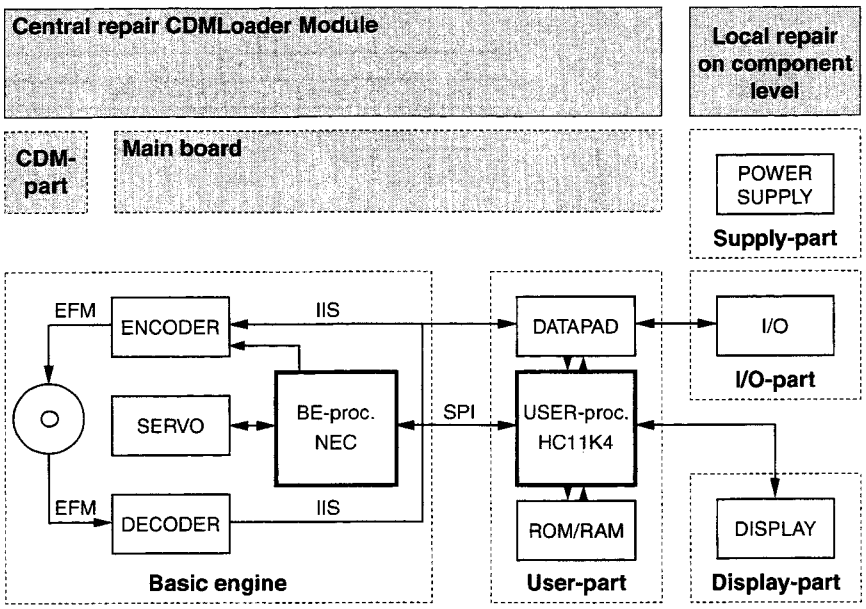

Figure 14
Central repair CDM loader module

For easy diagnostics of the CDM Loader Module, the set is equipped with a selfdiagnostics program.
This basic description contains some details of the working/ functions of the CDM Loader Module.

All functions in the recorder can be divided into mechanical activities with the disc and separate electrical circuits.
In chapter 3.2 and included paragraphs the mechanical part with its control systems with the encoding and decoding is described, in chapter 3.3 and its paragraphs the rest of the Electrical part is explained.

On next drawing the OVERALL BLOCKDIAGRAM is shown.

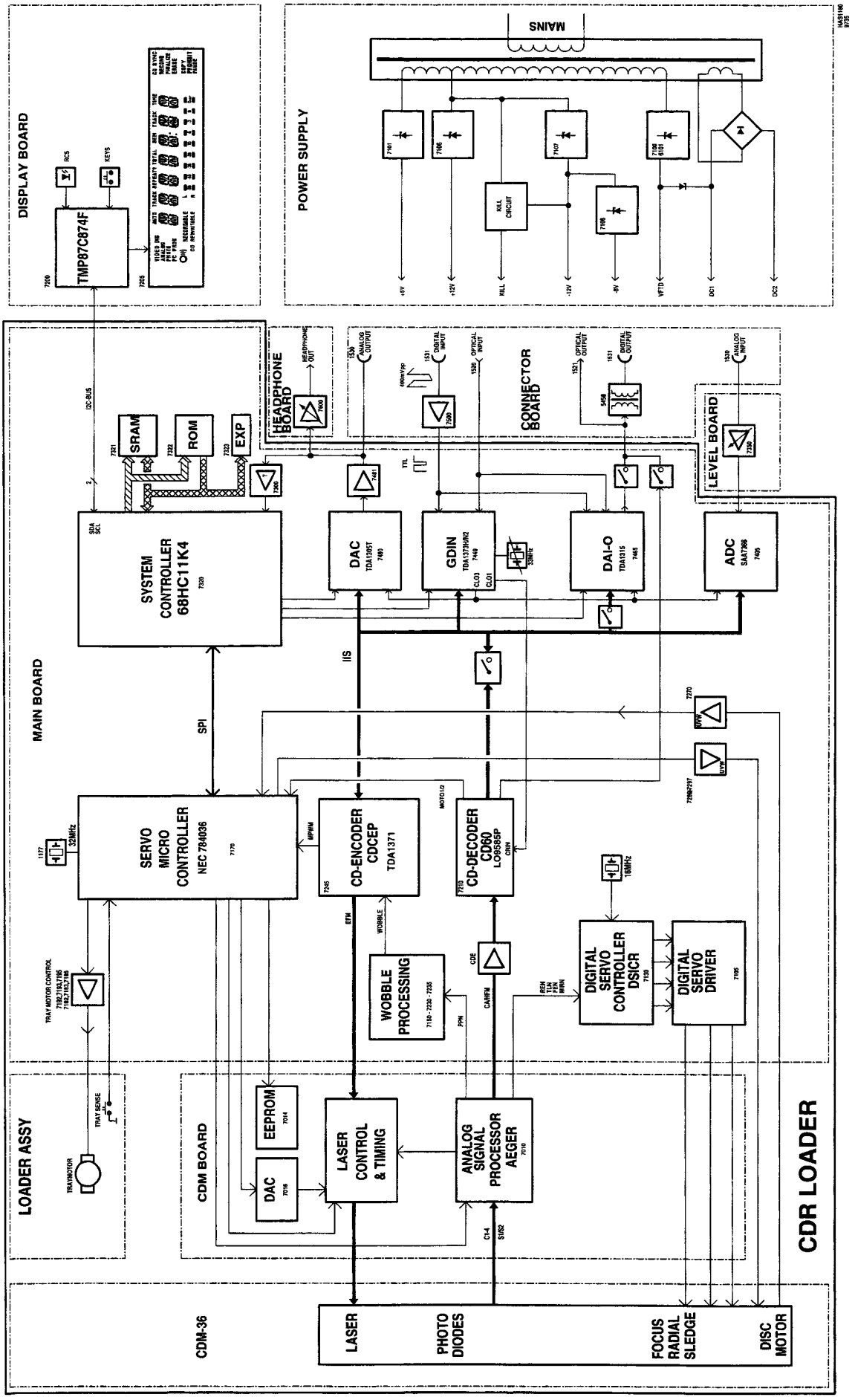

Figure 15
Overall blockdiagram

On the more extended overall blockdiagram most important components are shown again. The electrical signal flow of the recording signal from the analogue input on the connector board is as follows:
- the analogue recording level is adjusted on the level board and then
- the A/D conversion (ADC) to I^2S format (datapath);
- the Digital Audio Input (DAI-O) and General Digital Input (GDIN) are inserting the coaxial and optical input signals which are converted into I^2S format (datapath), from Datapath the signals are sent to
- the Compact Disc CIRC-EFM Encoder Plus (CDCEP) which encodes the signal into EFM, then the signal is lead to
- CDM Board with the Laser & timing unit and on
- CDM36 the Laser Driver Unit is processing the signal onto the disc. The processing of all these activities is mastered by
- the System Controller. The servo drivers on the CDM board are driven by commands from
- Servo Microcontroller and
- the scanning of input keys is processed by the slave µP on the display board.

The **analogue inputs** are pre-amplifiers which adapt the signal level to the operational level. Adjustments can be done about the **recording level**. Prevent over-amplification of the analogue signal because clipped audiosignals are registered as mutes and are "damaging" the recording quality. For that it is better to have a "safe" input level. After that the analogue audio signal will be converted in **ADC** into the I^2S format.
The **digital input** from the IEC958 standard format with data in Biphase marked code needs no adjustment and will be transferred into the I^2S format too by **GDIN**. The subcode information of the digital input signal will be processed to the subcode information for the new CD-R or CD-RW disc.
The I^2S signal is converted into the CIRC/EFM format in the **CDCEP encoder**. Each input audiosignal is worked up to the EFM format which will be written on the disc via the **Laser & Timing device** on the **CDM board** and **laser device unit** on the CD mechanism **CDM36**.

In case both inputs (analogue and digital) are supplying signals, preference is given to the digital input source.
The digital input, but also the I^2S signal from the analogue input, are connected to **DAI-O** which calculates a new digital output signal. Via the I^2S signal to the DAC IC the analogue output signal is also available. So for monitoring both digital and analogue output signals can be used.

On the Main board the "User" µProcessor (System Controller), scans via the **slave µProcessor** the keyboard for commands from the user. After that the user µP executes that command.
The user µP or System Controller is the heart of the set.
It co-ordinates all functions within the set. The writing process in the CDR-loader is controlled by the components on the CDM Board. This board consists of a.o. a laser control and timing device. On this board the reading and writing moments are started and the laserdiode will be actuated at correct level (reading CD, reading CD-RW, writing CD-R, writing CD-RW) and the laserlight will be processed onto the disc.

During the writing operation the wobble processing device takes care for the track following of the pregroove. This is done during the reading moments. At the same time the disc rotation is controlled via the ATIP-pregroove wobble information. As long as the recording disc is not finalized the ATIP information is processed for controlling CDM, even in playback mode.
When reading a conventional or finalized disc the driver control is switched to the well-known EFM-motorcontrol (MOTO 1/2) and the wobble processing is switched off.

On the CDM Board there is also the AEGER IC (Analogue Error signal Generator for Erasable and Recordable CD) with a normalizer circuit. This internal circuit amplifies all signals from the Light Device Unit to the same average level as the total reflected signal. By this adaption all photodiode signals are brought to a "normal" level. Now servo signals like Focus-error, Radial-error can be processed better. Even the HF-signal will be equalized in the AEGER.

The parts that provide output signals are in principal the same stages as known from the conventional CD-player where the EFM signal is recovered into the audiosignal:
- the CIRC-EFM decoder (CD60) decodes to I^2S datapath bus format, from this to
- the D/A conversion (DAC).
- the digital outputs are received from CD60.
- the analogue output from DAC.

Notice that the signal available for monitoring in the recording mode is not the recorded signal but it is only the input I^2S signal which can be controlled. In case the original input signal is an analogue input this signal can activate automatic track increment. If the output level via the internal monitor indicates a signal below -60 dB, the next track will be generated. In the digital input mode the subcode information indicates the next track. There is no need to say that all these functions are processed by a system microprocessor software program on the MAIN Board.

In the following an example of the use of a recording disc and a short description of the activities in the recorder.
After that the power on and open tray keys have been activated, the unrecorded disc (e.g. CD-R) will be put on the tray. Close the tray and the information on the area of the lead-in will be read. Because it is an unrecorded disc there is no information in the lead-in. Now the spot has been moved under the PMA area and the system controller switches over to so-called "ATIP-mode", pregroove information. The brand-new disc has not been recorded before so there is no information too. In the pregroove the recorder finds a recommended Optical Power Calibration value. Now this recommended power is taken as the middle of the 15 steps to make a test recording on the pregroove in the Power Calibration Area of the disc.
After recording, the written value is being read. If the intensity of the reading signal corresponds with a calibrated value the power ok sign is indicated and the corresponding OPC-value is stored. (See paragraph 3.2.2.2.) If after one run the ideal value is not found the next 15 steps are written on the disc. This procedure can be repeated 4 times. All figures of the disc are stored in the memory of the microprocessor.

After this OPC procedure, one can decide to make a recording of a piece of music. This will be written in the first track, "under" the pregroove on the reflection layer of the disc in the recording layer area.

Note: the ATIP information on pregroove remains. Only by diffracting the dye-layer new information is stored on "pit" spots. As long as disc is not finalized the recorder is able to read ATIP information.

To stop the recording the stop key has to be activated. The writing continues to the next subcode sync and another 26 (EFM-)frames more. (See paragraph 2.5.5.6. General linking rules.) First after recording those 26 frames the CD-R drive stops recording in the data area of the disc. Immediately, all stored information in the microprocessor, like disc number and the number of registered tracks, will be written down in the PMA of the disc. (See paragraph 3.2.2.2) After that procedure the tray is allowed to bring the disc outside the recorder.

To continue the recording on the same disc the close key has to be activated. Now still there is no information on the lead-in area but in the PMA the key identification information of the disc has been found. For each new record a new OPC is made. In this area it is possible to record only a maximum of 99 testrecordings.
However with the temporary table of contents in the PMA of the disc, the microprocessor knows the last track and drives the spot (Light Device Unit) to the end of that recorded track. To link to that position the recorder looks for the last recorded subcode sync framenumber. When the recording should start the recorder starts reading at first the last 26 EFM-frames to assure the timing of the registered signal with the timing of the new recording signal. After those 26 EFM-frames the writing starts. In this way there exists a continuous EFM pattern on the disc which is adapted to the conventional standard.
For CD-R discs the Power Calibration Area (PCA) can only record a maximum of 99 OPC testrecordings. To prevent that to often loaded discs are full without any recording the last (99th) OPC recording is used for all further recordings. So user should prevent loading discs to often without making a recording, to prevent misadjustments of OPC value.
The CD-RW disc does not have this limitation. After 99 OPC records have been stored in the PCA at the next OPC at first PCA will be erased and again 99 OPC values can be stored.

At the end of the recording the recorder operates in the same way as already described. Before opening the tray it is possible to decide that this recorded disc has been completed. Now the fixing up procedure (finalizing) may be activated. Then all the content of the temporary table of contents (PMA) is transferred to the lead-in area. Behind the last track the lead-out information will be written. After the fixing up there is not any possibility to make another recording on this CD-Recordable Audio disc. But from now on the finalized CD-R disc can be played back on every CD-Audio player. Finalizing (fixing up) of a CD-ReWritable disc is done via the same procedure, however with this restriction that only CD-RW prepared CD-Audio players are able to play back this finalized disc.

In the next section the mechanical actions to get the information on and from the recording disc are described.

3.2 The Mechanical part with its control systems

In the mechanical part of the recorder the track following, focusing and reading and writing of a disc are carried out. All these actions are adapted to the new write and rewrite situation and should be compatible with the conventional CD-system.
These conditions are fulfilled by the CD-Recording drive.
A very important item of this drive is the Light Device Unit. This consists of the laserdiode with an optical 3-spots lightpath. This Light Device Unit is driven and/or controlled by the following electrical circuits:
- laser control,
- normalizer,
- focus control,
- 3-spot radial tracking system,
- motorcontrol.

All these functions are carried out in close co-operation with the servo microcontroller.

3.2.1 The CD-Recording drive

In the mechanical part of the recorder the following conditions are implemented.
- The spot follows the tracks very closely. Here has been chosen for an adapted 3-spot system with a 2-stage radial tracking slide mechanism.
- The mechanism is derived from the conventional CD-system.
- Writing of the PMA and PCA is done on the inner track before the lead-in. The spot has to be moved at 22 mm radiation from the middle. This requires an adequate functioning of objective, actuator and turntable motor. The mechanical part of the CD-Recorder has to be adapted to reach the new, most inside position.
- To get as much laserlight as possible on the disc, polarizing optics have been used. Also a couple of objectives has been added and a high power laserdiode has been applied.
- Tolerances of the tilting of the disc ask for adaption of the real time optical power. This is controlled by the real time Optical Power Control. (O.P.C.) See paragraph 3.2.2.2.

All these functions are implemented in the CD-Recording drive which consists of the CDM mechanism and the electrical circuitry which is concentrated on the CDM Board and on the Main Board.

The CD-Recording drive with the Light Device Unit constitutes an interface between the lightpath on the one hand and the encoder and decoder on the other hand. See figure 16: CDR drive blockdiagram.

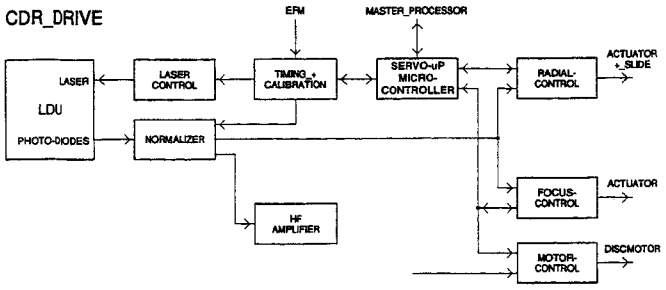

Figure 16
CDR drive blockdiagram

In the CDM mechanism the laser sends its output light to the disc through the lightpath. A part of the source beam is catched by the Forward Sense photodiode, placed just behind the grating. The resulting electrical FS photodiode signal is used to control the laser output power by means of a laser control circuit. The beam reflected by the disc is led to a photodiode system, where signals are generated on behalf of servo control and data extraction.
The CDM board contains the servo error extracting AEGER IC (Analogue Error signal Generator for Erasable and Recordable CD), the discrete laser control circuit and other functions.
The AEGER provides error signals for focus and radial servo control, a push-pull signal for disc motor control and a central aperture signal for disc motor control and data extraction.
The Main Board comprises most of the servo functions.
The DSICR IC incorporates the focus and radial servo transfer functions. The DSICR output signals are power amplified by the DSD driver IC and fed to the focus and radial actuator, as well as the sledge motor on the CDM mechanism.

3.2.1.1 The CDM mechanism

The CDM mechanism consists of the Light Device Unit and a 2D actuator. Both units are mounted on a slide which is driven by the slide motor.
Further on there is the Brushless Hall turntablemotor to spin the CD-disc.
The radial tracking system is a 2-stage servo with a 3 spot lightpath. Let us first compare the conventional lightpath with the CD-R lightpath.
The 3 spot lightpath of the conventional CD system consists of a laserdiode with the feedback information of the monitor-diode, grating, plane parallel plate, collimator lens, objective lens and photodiode. See figure 17.

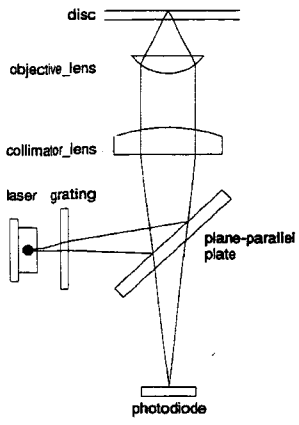

Figure 17
3 spot CD lightpath

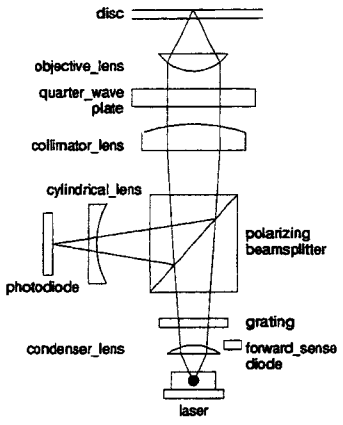

Figure 18
3 spot CD-R lightpath

The 3 spot lightpath of the CD-R lightpath consists of the following components:
- laserdiode, condenser lens, forward sense diode, grating, polarizing beamsplitter, collimator lens, quarter wave plate, objective lens, cylindrical lens, photodiode. See figure 18.

In the following a short description of this lightpath:
The condenser lens couples all laserlight to get a better result of the output of the laserdiode. The internal monitor diode of the laser is not in use in this path. Instead of that the forward sense diode has been used to measure the intensity of the output of the laser. Via the grating the lightbeam has been divided into 3 spots. The polarizing beamsplitter conducts all laserlight through the splitter. The collimator lens now forms parallel beams of the 3 spots. In the quarter wave plate the polarizing direction rotates for 45°. The moveable objective lens has been focused on the reflecting layer on the disc. The reflected beams return their way back to the quarter wave plate where again 45° rotation has been made.
Now the total polarization rotation comes to 90°. This means in the polarizing beamsplitter that all reflected lightbeams are diffracted to the cylindrical lens. The effect of this lens consists in the astigmatism of the spot on the photodiode. On figure 19 this effect has been demonstrated.

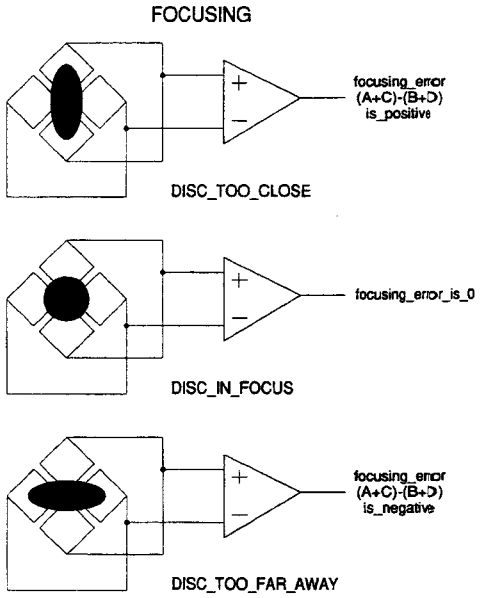

Figure 19
Focusing

Resuming: the differences between the 3 spot CD lightpath and the 3 spot CD-R lightpath are the polarizing components (quarter wave plate together with the beamsplitter) and the forward sense diode.

3.2.1.2 The CDM requirements

The CDM requirements are:
- Good spot quality
- Accurate track following
- Eccentricity < 100µm
- Low shocksensitivity
- Inner position: r = 22 mm

Good spot:
The used laserdiode is a high power laserdiode, to be able to write with enough power during the writing conditions. For the reading condition the laser has been switched on the low power level. To obtain in both situations a stabilized wave-length of the light the laser output in the read mode has been modulated with 200 MHz.
In the next section the accurate track following has been explained.

3.2.1.3 The 3-spots push pull system

In the CD-Recording disc there is a small pregroove on this disc. To find this pregroove the mechanism uses the satellite spots. These spots are positioned just in the middle between two tracks and not, like the conventional 3-spot CD system, at the border of the track. The second deviation of the conventional system is that the photodiodes of both satellite spots are divided into two parts. With these modifications a push pull signal can be constructed. On figure 20 the effect of push pull has been shown.

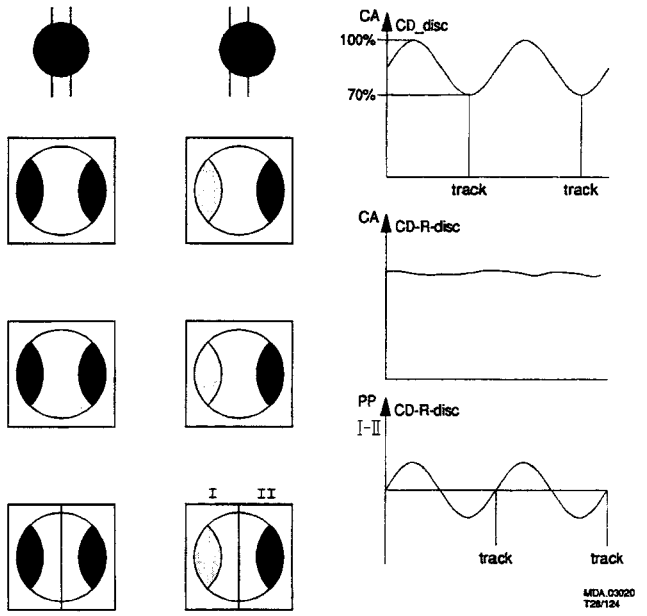

Figure 20
3 spot push pull tracking

As already known from the conventional CD system there is a difference between the intensity of a partly reflected light from a pit/land cross over and the intensity of the reflected light from a complete land spot and the intensity from a complete pit spot. The second order reflected light from the cross over shows a third level light intensity. By dividing the satellite photodiodes in two pieces the intensity of both reflected parts can be subtracted and a recognizable radial error signal is obtained.

3.2.1.4 shock sensitivity

The shock sensitivity should be as low as possible, because during the writing situation there is no possibility to correct that kind of disturbances. The prevention of a shock is so important because if it occurs during the writing mode the CD-Recordable disc should have been damaged irreparably. The reading time interval between the writing pulses is 13.3 ms. If after such a bump the timetable of the ATIP (Absolute Time In Pregroove) information does not continue, the laser is switched off. In the CD-Recordable/ReWritable recorder there exists a recovery protocol which can save a part of the recordings on both disc types. See next example.

Example: *Recorder is writing on a CD-R disc. After having recorded 3 pieces of music (tracks) perfect there is a bump against the set during the recording of the 4th track. Now the writing current of the laser is switched off, as described above. However before opening the tray, the recorder starts finalizing this disc, otherwise all information in the master µP should have been lost. This disc however, will only consist out of the 3 perfect recorded tracks. Not any track can be added (because it is finalized) but in this way the 3 perfect recorded tracks are saved. The reason for doing so is that it is impossible to connect new EFM signal in a good shape to the suddenly interrupted existing EFM pattern. That's why the last track is decided to be lost and the CD-Recordable disc can be used only for the already perfect recorded and completed tracks.*

In case the same accident should happen with a CD-RW disc, then only 3 tracks are stored in PMA and when a new recording should be added it will be inserted automatically after the third and perfect recorded piece of music. The already recorded part of the music from the 4th track will always be overwritten. However the ReWritable disc can be filled completely afterwards.

3.2.1.5 focus radius

The focus radius is the minimum distance between the spindle of the turntable motor and the objective. This distance deviates from the existing CD format because the PCA and PMA areas are inside them. Now the stud for the objective is at a radius of 22 mm from the centre the spindle (was 23 mm).

3.2.1.6 eccentricity

The eccentricity is dependant to two circumstances. First the disc eccentricity, second the eccentricity of the spindle of the turntable motor. To lower the eccentricity of the spindle a selfcentring carrier has been applied. There is no need to say that the eccentricity for a recordable disc is more important than the eccentricity of a conventional disc.

3.2.2 The CDM board

The CDM Board contains the laser control & timing unit and the photodiode signals received from the CDM are processed in the AEGER IC for feedback of various servo loops. Together with the some IC's on the mainboard it supports the following processes like:
- Laser control (reading and writing)
- Optical Power Calibration
- Normalizing
- Turntable control (reading and writing)
- Focus servo
- Radial servo
- HF-signal input and equalizer
- EFM detector

All these processes are under control of the timing unit. See figure 21.

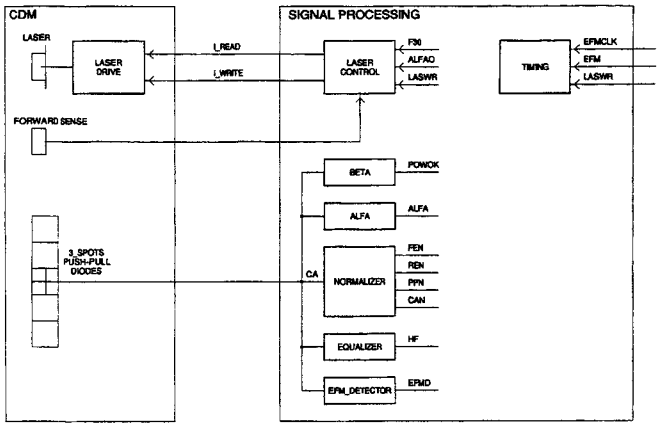

Figure 21
Blockdiagram of the CDM Board with CDM mechanism

3.2.2.1 Laser Control

The laser output level has to be stabilized by the forward sense diode. For that reason the forward sense has three reference currents to compare with.

- The read current.
- The write low current.
- The write high current.

The timing unit switches between the read and write power stages and the output signal has been controlled according to the EFM signal. See figure 22.

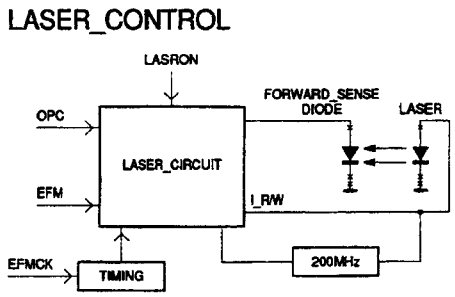

Figure 22
Laser control

The read current is the lowest current in these three situations. To get a proper working of the laser with such a low current the DC current has been modulated with a frequency of about 200 MHz. The levels of the laser write power have been determined by the Optical Power Calibration.

3.2.2.2 Optical Power Calibration

In the read mode the power of the laser has been determined by the fixed value of the read current. During writing the write current has to meet with the adjusted value of the Optical Power Calibration recorded on the used disc. The signals which control these levels are from the so called Beta circuit. To optimize the recording this Beta value has to be checked during the writing operation. In case there is a black dot, fingerprint, tilting or dust this results in a lower power intensity on the disc. That's why the write current has to be adapted to an optimum recording due to the variable conditions of the disc. These adaptations have been carried out by the Alfa circuit.

First look at the Beta reference measuring which has been checked at the moment the first Optical Power Calibration has been carried out. If the recorder reads an unknown disc the first thing he does is to make a testrecording on that disc. With the Power Calibration Procedure the Light Device Unit has been moved to the Program Calibration Area where the information has been stored of the position of the first free Power Calibration part. During 15 consecutive ATIP frames a random EFM signal has been written with an increasing power (FSO) at every frame. The power range of those 15 steps is 7 below and 7 above the advised OPC value in the ATIP lead-in. After the writing the first position is being looked for and the next 15 ATIP frames are read to find out which frame satisfies the critical condition of the writing power. See figure 23.

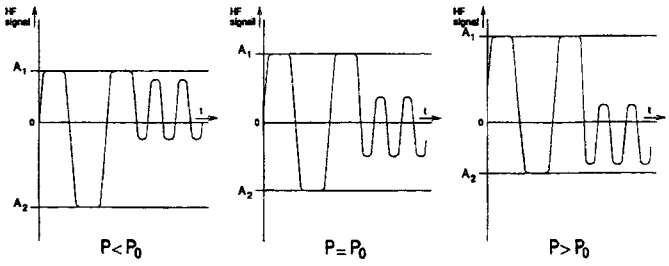

Figure 23
The power ok decision

The values from that frame such as the FSO (Forward Sense Offset) and Alfa (Powerabsorption) are registered as setpoints to FSO and Alfa0. In recordings later on these values take care for adjusting the output level current at the OPC level.

On top of that there is an additional power regulation to obtain a constant absorption in the disc. It is the intensity of the absorption which results in the deforming of the disc. This depends of the local quality of the disc, the spot, tilting, dust and fingerprints. This function has to be controlled during the writing by the ALFA circuit. The principle of sample and hold has been used to measure the intensity of absorption. At the beginning of a write pulse the intensity is a high write current. This is always the same pulse (current and time value). After that pulse, the contents of the EFM signal together with the timing unit, decide how long the low write current continues. At the same time that the high pulse has been transmitted, the reflected light is also measured (reading). The difference between send pulse and reflected pulse is a gradation of the absorption. See figure 24.

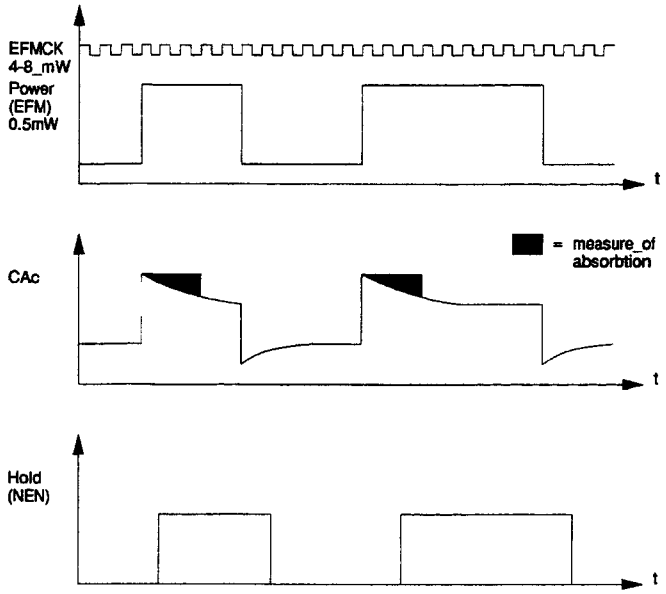

Figure 24
Sample and hold

In the Alfa circuit this measured absorption has been compared with the stored absorption values of the first Alfa0 setpoint. The difference has to be corrected via the Alfa circuit.

3.2.2.3 Normalizing

The normalizing function normalizes the photodiode signals from the LDU. The reason for normalizing is the great difference in reflection of various discs. To prevent the influences of these variations in the rest of the circuits all photodiode signals are brought to the "normal" level in the beginning of the circuit. The normalizer processes in this way the sum-signal of the mainspot called: Central Aperture (CA), but also the focus and radial error signals. The output signals are called FEN, REN, CAN. From the CA signal is made a push pull signal too. That normalized signal is called: PPN. From the HF-sumsignal the HF signal has been formed. In the read mode this signal has been directed to the decoder panel after equalization in the Modulation Transfer Function. In the write mode this signal has been switched to the Alfa circuit.

3.2.3 The Servo Functions

The electrical circuitries of the turntable motor control and focus and radial servo drivers are on the main board. These servo circuits execute the recorder commands via an own servo microcontroller (Servo µP) and the main functions are:
- communicating with the master µP (System Controller).
- processing the single commands from the master µP.
- reporting the error conditions to the master µP.

The servo devices on the mainboard also processes the error signals received from AEGER IC on the CDM Board like:
- controlling the turntable motor in recording and play-back mode.
- controlling the focus- and radial actuator.
- controlling the slide movement.

3.2.3.1 Turntable Motor Control in recording and play-back mode

In the read mode the turntable motor has been controlled by the Pulse Width Modulation (PWM) signal from the CD-Decoder. In this IC the received HF sumsignal (HFM) from AEGER is sliced and fed to a phase locked loop circuit after which a FIFO is filled with the extracted data. Nominally the disc speed should be such that the FIFO is filled halfway. The amount the FIFO is filled is compared with the nominal value and the resulting error signal is the MOTO 1/2 signal used to activate via the Servo microcontroller the turntable motor control circuit. In the write mode the ATIP information in the pregroove is used. This groove carries a modulated frequency of 22.05 kHz. This frequency is present in the PPN signal from AEGER. To have speed adjusted the received wobble frequency is compared with the fixed frequency in the wobble processing unit. Via CDCEP the MPWM signal is sent to the servo microcontroller, which controls on its turn the turntable Hallmotor.

3.2.3.2 Focus servo

After normalization in the AEGER the focus error signal (FEN) will be directed to the Digital Servo IC for Recordable CD (DSICR) on the Main Board.
The focus servo function starts with the start up, to move the actuator through the focal point. From the DSICR the digital message focus found will be sent to the Servo micro controller. Other digital signals are directed to Digital Servo Driver IC (DSD) to keep the spot in focus with the disc.

3.2.3.3 Radial servo

After normalization in the AEGER the error signal of radial servo (REN) will be directed to the DSICR.
The radial servo delivers the following functions:
- radial actuator control.
- slide movement control.

During normal tracking operation the REN signal is processed in the AEGER into a DC error signal which provides the radial actuator. Most of the time the slide motor is not driven.
The radial actuator, while keeping track, will slowly move outward related to the slide and this is resulting in a growing radial integrator voltage. Each time this voltage exceeds a certain value, a slide step is generated, resulting in a sudden outward movement of the slide and hence a radial error drop. Much more functionality is required during all kinds of non-linear operations, like starting up, catching track, jumping, playing across drop-outs, handling shocks and so on. All these operations require many additional switching functions which are provided in DSICR. These transfer function coefficients are programmed in the EEPROM.

3.2.4 The Wobble Processing

In the recording mode the normalized HF-signal (PPN) is lead to the wobble processing unit. Here the pregroove information has been decoded. The carrier frequency of the PPN signal (22.05 kHz) is compared to a reference frequency. The result is converted into an errorsignal that controls the turntable motor and the modulation on that carrier is demodulated to the time-code information.

In play-back mode of a pre-recorded disc the total wobble processing is switched off and the motorcontrol signal from Decoder is used to control the turntable motor.

3.2.5 The Servo microcontroller

The Servo microcontroller coordinates all functions of the laser control, servo-, AEGER-, Wobble-, Encoding- and Decoding-processing. The System controller actuates all those processings.

3.3 The Electrical part

The electrical part of the CD-Recorder/player can be split up in the arrangements of the incoming audio signal which should be prepared to be converted into the EFM-signal, and the EFM-signal which have been read should be converted into the audio output signal. The first function has been carried out by the input part with the encoder path, the second by the decoder path with the output part. Both parts are transporting the digital data in the set. That's why this bus is often called Data Path. On the overall blockdiagram at figure 13 all these units have been drawn.

3.3.1 The input part of the circuit with the ENCODER path

In the CD Audio Recorder is in recording mode the electrical input signal will be written to the disc. The encoder which takes care of coding into EFM format wants to get an I^2S digital input signal. That's why all input signals are converted into the I^2S format. The analogue signals are converted in an A/D converter into this format. The optical or electrical digital information at the input has to be converted to the I^2S signal too. This happens in the Digital In circuit.

3.3.1.1 Digital In

Digital signals (optical or electrical), according to the Digital Audio Interface, an IEC standard with bi-phase modulated information, are converted in the General Digital Input IC (GDIN) into the Datapath I^2S bus format. After this conversion all subcode information has been sent to the µP to generate a new subcode. On figure 25 the blockdiagram of this GDIN IC is shown. The IC is able to perform a sample rate conversion of digital signals. (SRC Mode) It can also read several serial input formats in the IEC958 digital audio format. For that a full Audio Digital Input Circuit (ADIC) is present. An internal digital PLL circuit clocks the incoming signal jitter free.

Blockdiagram

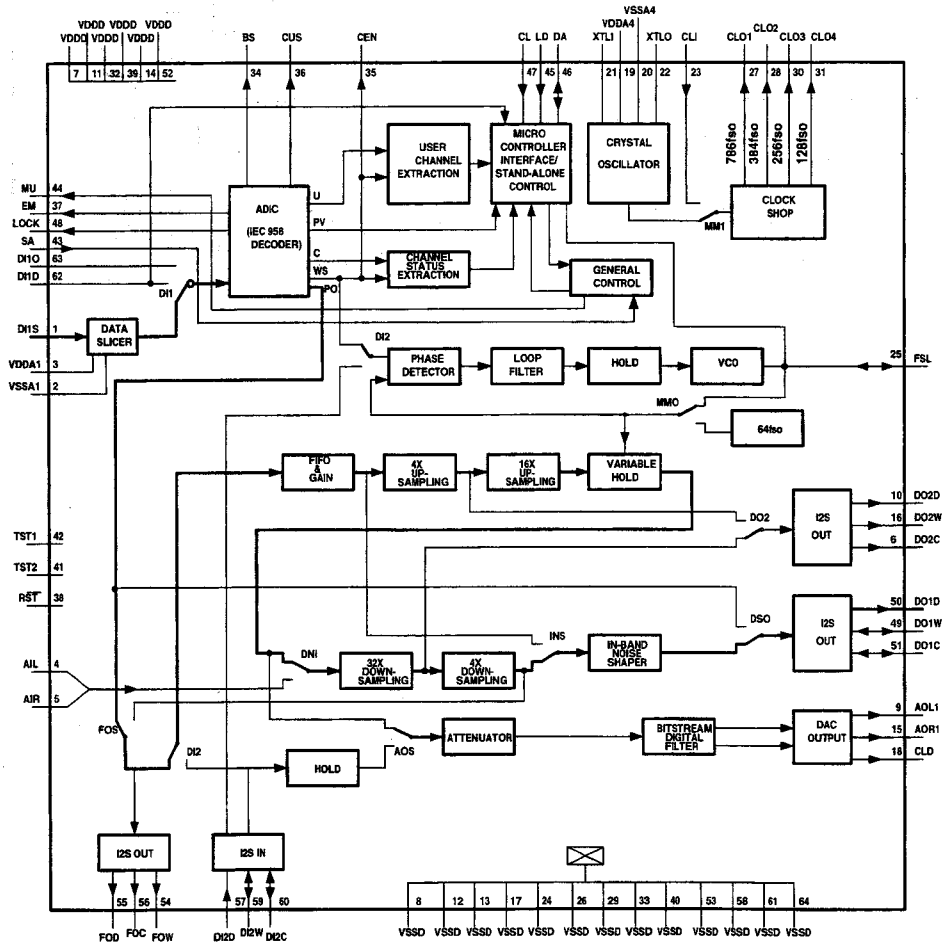

Figure 25
Blockdiagram of the General Digital Input

The Digital Audio Input/Output circuit (DAIO) calculates a new digital output signal. So digital Monitoring of the input signal is possible via this output signal. See figure 26.

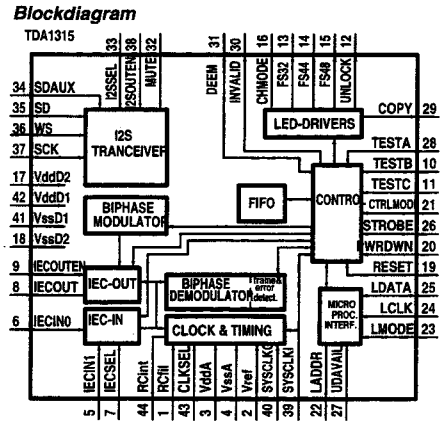

Figure 26
Blockdiagram of the Digital Audio input/output

3.3.1.2 *Analogue Digital converter*

The analogue input signal is converted in the Analogue/Digital converter IC (ADC) into the I^2S bus format. In figure 27 the blockdiagram of this IC is shown. Conversion is done via the Sigma/Delta modulator. After that the digital data is led to the CDCEP (Compact Disc CIRC Encoder Plus) via the datapath bus.

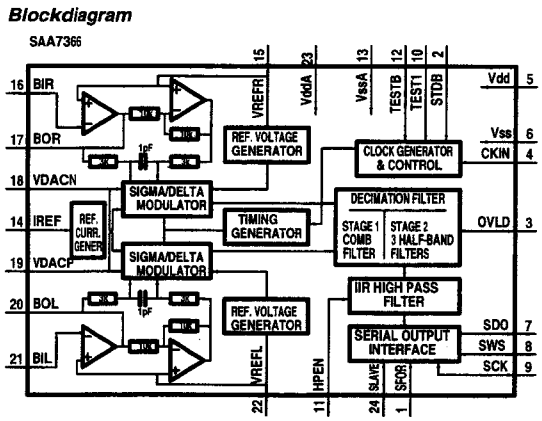

Figure 27
Blockdiagram of the conversion from Analogue to the EFM format

3.3.1.3 *Cross Interleave Read/Solomon Code to Eight-to-Fourteen-Modulation (CIRC EFM) Encoder*

In the CDCEP the I^2S signal will be converted into the EFM format. To get this format the data has been shifted into a RAM memory, split up in symbols and read out via the encoder pattern. In the CIRC circuit the error correction symbols will be added. Also the subcode information from the master µP will be prepared in the subcode shiftregister and the subcode bits are also added via CIRC to the EFM format. Here e.g. the copy bit information has been written to the disc. After that the conversion from the 8 bit symbols to the 14 bit has been done and 3 merging bits are added to each 14 bit pattern. Resulting in the writing EFM-signal. On figure 28 the blockdiagram of CDCEP encoder is shown.

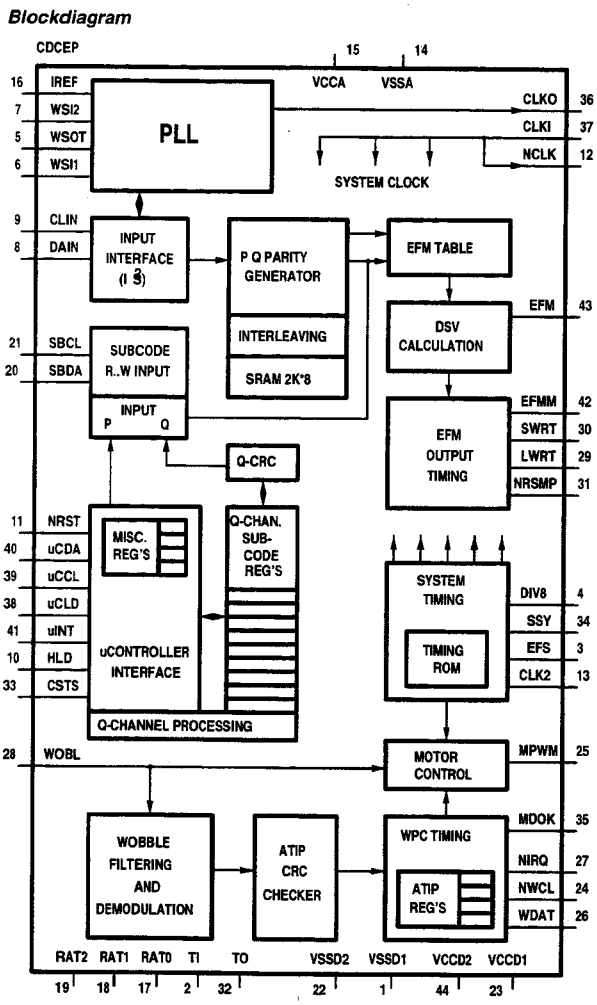

Figure 28
Blockdiagram of the CDCEP encoder

3.3.2 The output part of the circuit with the DECODER path

In the playback mode the reading of the EFM on disc is done. The HF signal from the disc is decoded in the Decoder IC CD60. In play back mode the I^2S signal from the decoder has been put through via the Datapath to the DAC IC and further on to the analogue output stage. On next figure the blockdiagram of the Decoder IC has been shown.

Block diagram

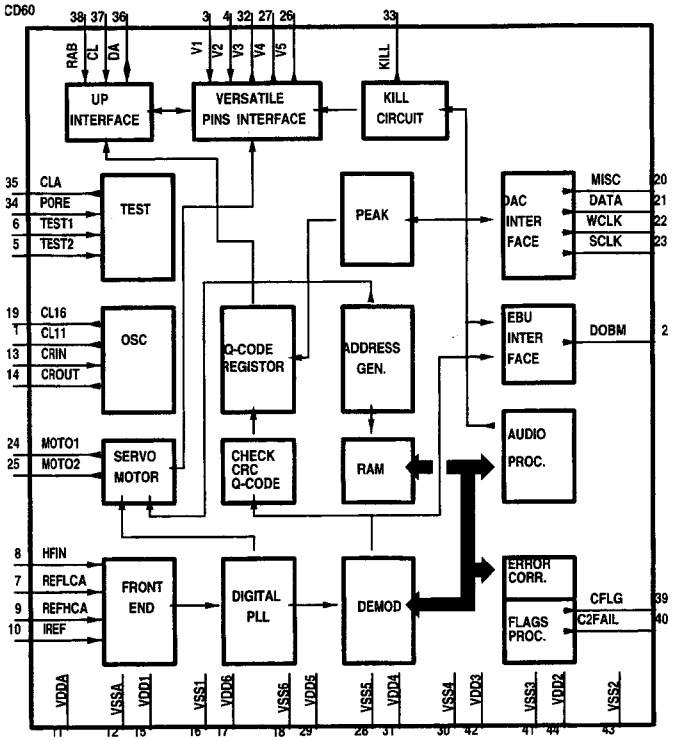

Figure 29
Blockdiagram of the CD60 decoder

3.3.2.1 DAC analogue output

The same Digital to Analogue Converter (DAC IC) as applied in the conventional CD player will be used in the CD-Audio Recorder/player.

3.3.2.2 Digital output

From Decoder CD60 is used the DOBM signal (IEC958 format) to connect this signal via an electronic switch to the digital output connector.

3.3.2.3 Monitoring

Monitoring of the input signal at I^2S level is possible via the direct digital out and analogue out generated from the same I^2S datapath information. However it is not possible to read and write at the same time the disc information. That's why the "monitor" signal does not proof the written signal.